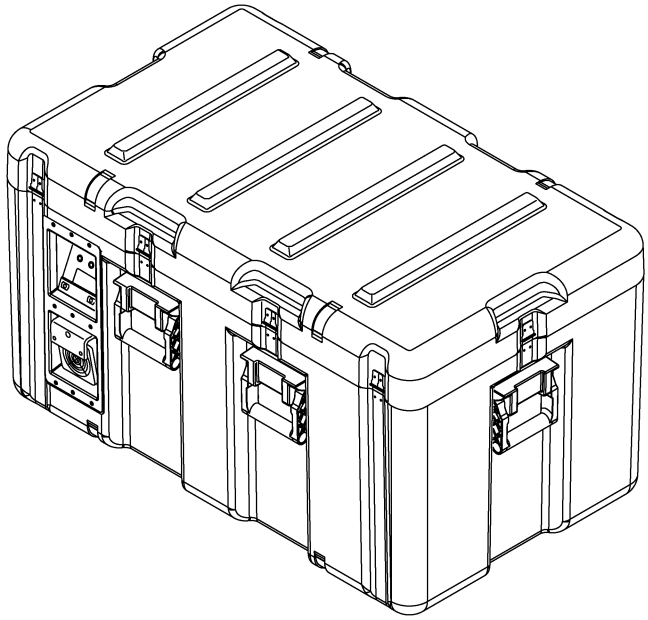
OPERATING INSTRUCTION
TWO-TEMPERATURE HemaCool®

Advanced Technology Blood Product Storage and Transport Refrigerator/Freezer
Model HMC-MIL-1

NSN 4110-01-506-0895



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HemaCool® Operating Instruction

Revision 2

May 2005

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CHAPTER 1. INTRODUCTION

Section I. System Familiarization

1-1. EQUIPMENT DESCRIPTION

a. The HemaCool® is a conventional liquid/vapor-phase refrigerator with a number of special enhancements:

(1) HemaCool® employs vacuum insulation panels to decrease the power required to regulate temperature in a given environment, to increase holdover time when energy sources are lost or disconnected, and to increase internal temperature stability.

(2) In the COOL mode (4°C (39ºF) set point), the unit prevents payload freezing in sub-zero environments by applying heat, rather than cooling.

(3) The unit's control system works with a number of different power sources without special adapters. This power system includes internal batteries that allow the HemaCool® to operate for a time without external power (see Operational Specifications, Paragraph 1-4).

(4) The HemaCool® includes integral monitoring and logging of payload compartment temperature and battery charging state.

(5) The HemaCool's® internal design is arranged to accept baskets for holding blood bags (or fresh frozen plasma bags when the unit is operating in freezer mode).

(6) Small internal fans help circulate cooling air, to maintain uniform temperature.

b. The HemaCool® is designed to preserve liquid or frozen blood products and medical supplies. HemaCool® provides exceptional field storage through its combination of superior insulation technology and temperature controls, based on microcontroller solid-state electronics.

c. The HemaCool® is portable and self-powered, utilizing internal batteries. The system will accept electrical power from multiple sources, e.g., 12-28 VDC from batteries or other DC sources at the DC power input, or from a wide range of grid power standards (any combination of 100-250 VAC and 50-60 Hz line frequencies) at the AC power input.

d. If the unit is fully stocked with conditioned contents and no power is applied (unit off), it will take more than 2 hours for the internal payload temperature to rise from 4°C (39°F) to 6°C (43°F) in an ambient temperature of 49°C (120°F).

(1) The HemaCool® will perform in either the COOL or FREEZE mode.

(a) In the COOL mode (4°C (39°F)), the unit, provided its two internal 21-amp-hour batteries are properly charged, will maintain a temperature range of 1°C (34°F) to 6°C (43°F) for more than 24 hours at 24°C (75°F) ambient temperature.

(b) In FREEZE mode (-22°C (-7°F)), the unit, provided its two internal 21 amp-hour batteries are properly charged, will keep blood products frozen for more than 8 hours, at an ambient temperature of 24°C (75°F). Freeze mode operation does, however, reduce the battery-powered hold time. (See Operational Specifications, Paragraph 1-4).

(2) For additional payload security, the HemaCool® is also equipped with an internal heater that will prevent a refrigerated payload from freezing if the unit is in an environment that is below 1°C (34°F), but no lower than -20°C (-4°F).

e. The standard default temperature scale setting for the HemaCool® is Celsius (°C).

1-2. FEATURES

NOTE

This manual assumes that when viewing the HemaCool®, the front is the side with the internal lid latches. The display screen is on the left when viewed from the front. Viewed from the front, the compressor and electronics compartment is on the left side of the machine, while the batteries are under the cover panel on the right side.

The HemaCool® is ergonomically designed for quick response operation in the world's harshest operating environments and incorporates the following features. Figure 1-1 illustrates these features.

a. Tough Mil-Spec Case (1).

b. Six tie-down-rated carry handles for two- or four-person carry transportation (2).

c. Ten positive locking latches for secure storage and transport (3).

d. Power panel for control and connection to external power sources (4).

e. Display and control panel for operator interface (5).

f. Easy load/unload baskets that allow convection around packs for even cooling (6).

g. Vacuum panel insulated lid (7).

h. A cover panel to store all required cables and accessories (8).

i. The HemaCool® can be stored in temperatures from -30ºC (-22ºF) to 65ºC (149ºF).

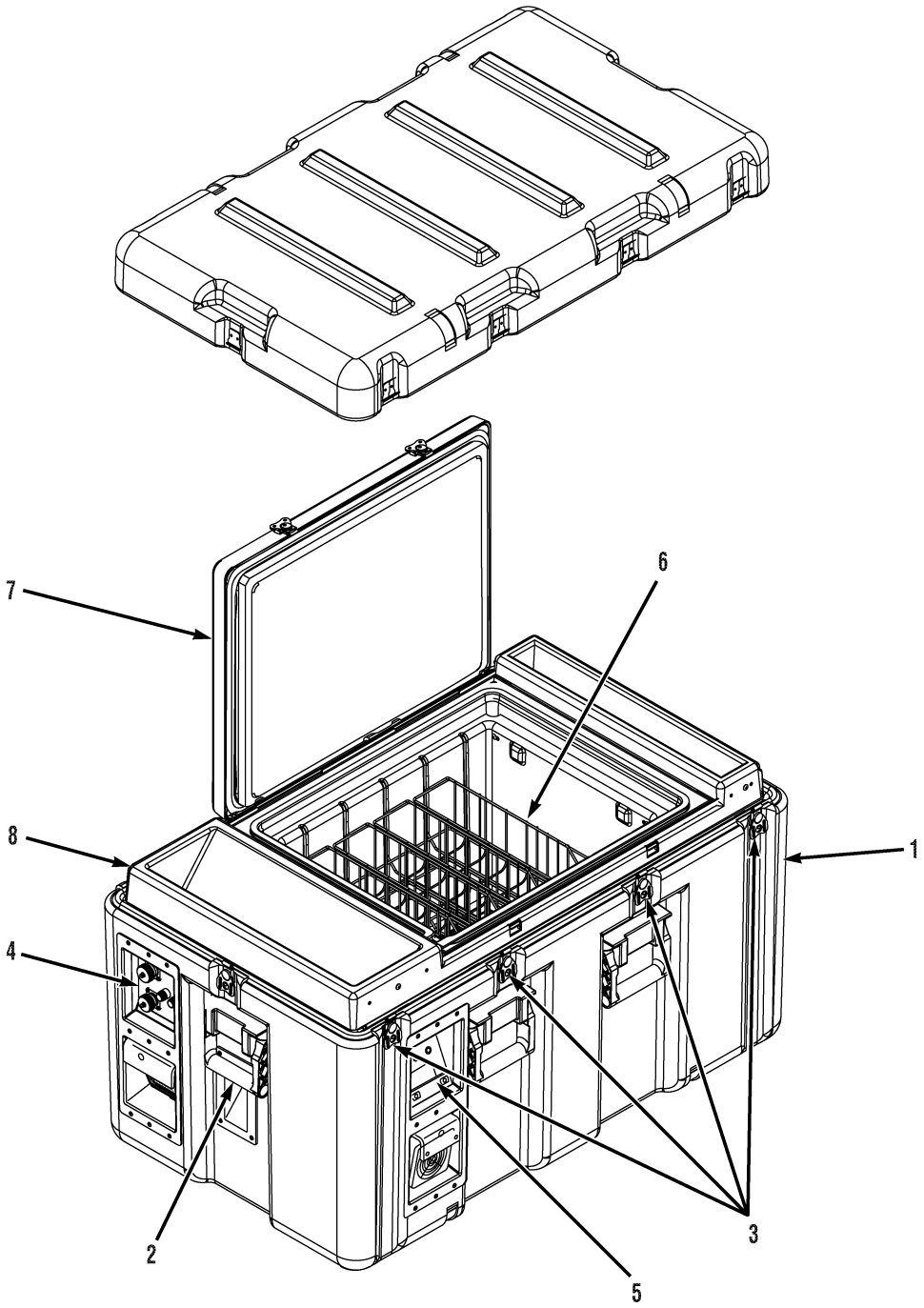


Figure 1-1. HemaCool® Features

1-3. PHYSICAL SPECIFICATIONS

a. Payload volume:
2 cubic feet (56.6 liters)

b. Payload bay dimensions:
13 in. (33.0 cm) H x 14 in. (35.6 cm) W x 18 in. (45.7 cm) L

c. External dimensions:
21.8 in. (55.4 cm) H x 21 in. (53.3 cm) W x 37.5 in. (95.2 cm) L

d. Empty weight:
142 lbs (64.5 kgs)

1-4. OPERATIONAL SPECIFICATIONS

a. Internal temperature regulation:
COOL mode: 4.0°C ±1°C (39°F ±2°F)
FREEZE mode: -22°C +0/-6°C (-7°F +0/-11°F) in 30°C (86°F) ambient or lower temperature

b. Estimated power consumption during COOL mode startup:
<40 W at room temperature (55 W at 40°C (104°F)) ambient

c. Estimated power consumption for COOL mode storage only:
<20 W at 40°C (104°F) ambient

d. Payload capacity:
40 x 450 ml units or 60 x 250 ml units.

e. Batteries:
12 volt, 42 amp-hour total capacity
- Set contains two 21 amp-hour batteries
- Battery weight (total): 27 lbs (12.2 kg)
- Provide 24 hours of operation in storage only mode

f. The HemaCool® accommodates a variety of power sources:
- Batteries or external 12-28 VDC to auxiliary input
- AC power from grid or generator
- Grid power required: Any combination of 100-250 VAC and 50-60 Hz

g. The HemaCool® employs environmentally safe R 134A refrigerant.

h. The HemaCool® is designed to be operated in temperatures from -20ºC (-4ºF) to 49ºC (120ºF).

i. The HemaCool® can be stored in temperatures from -30ºC (-22ºF) to 65ºC (149ºF).

1-5. NORMAL OPERATION

a. Figure 1-2 is a functional block diagram of the HemaCool® as described below.

b. In normal operation, the evaporator temperature sensor (Figure 1-2) is monitored by the control board processor chip, which compares its output to an internal look-up table. This table lists the evaporator temperatures that the compressor should turn on and off to maintain the temperature selected on the power panel. The on/off function is performed by an optically isolated MOSFET switch on the control board that is routed to the compressor through the power board. This switch acts in place of the conventional thermostat switch to tell the compressor driver to run the compressor and fans.

c. The compressor can operate in two speed settings: slow or fast. Each time the compressor is started, it runs in slow speed. If the compressor runs continuously for 2 minutes, and the temperature has still not reached the desired target, the compressor switches to fast speed. It continues to run in fast speed until it cycles, or is turned off.

d. When the control temperature selection is changed, it tells the control board processor to use a different look-up table.

e. Because thermal contact between the evaporator and the payload is made through air circulated by the internal fans, it is imperfect. In above 0ºC (32ºF) ambient temperatures, this means the evaporator runs cooler than the payload temperature. The only exception is when the heater operates to prevent payload freezing in outside ambient temperatures of below 0ºC (32ºF).

f. Because of the temperature difference between the payload and the evaporator, as well as to have faster response, the temperature sensor for the evaporator is separate from the payload compartment temperature sensor and mounted directly on the evaporator.

g. The payload compartment temperature sensor is monitored by the microprocessor to alert it to any failure of the temperature regulating system and to generate the temperature readout in the display. Temperature information supplied to the data logger is provided by the payload, evaporator, and ambient sensors.

h. The processor takes a new reading of the temperature (and also of battery voltage) every 1.25 seconds. It averages eight readings before updating the display. This means the display updates every 10 seconds.

i. When the unit is operating on DC from its batteries or DC auxiliary power, the internal and external fans operate only when the control board operates the compressor.

j. When AC power is available, the AC to DC converter runs constantly to keep the batteries charged, and the condenser coil blower runs constantly to exhaust heat from the converter. The internal fans are switched through a magnetic reed switch operated by the payload compartment lid. If the lid is open, the internal fans are turned off to prevent the mixing of outside air with the payload.

k. The control board determines which power source is used to operate the unit. This ensures the AC supply takes over for the batteries and charges them during operation. A manual temperature or other change may not be displayed for 10 seconds.

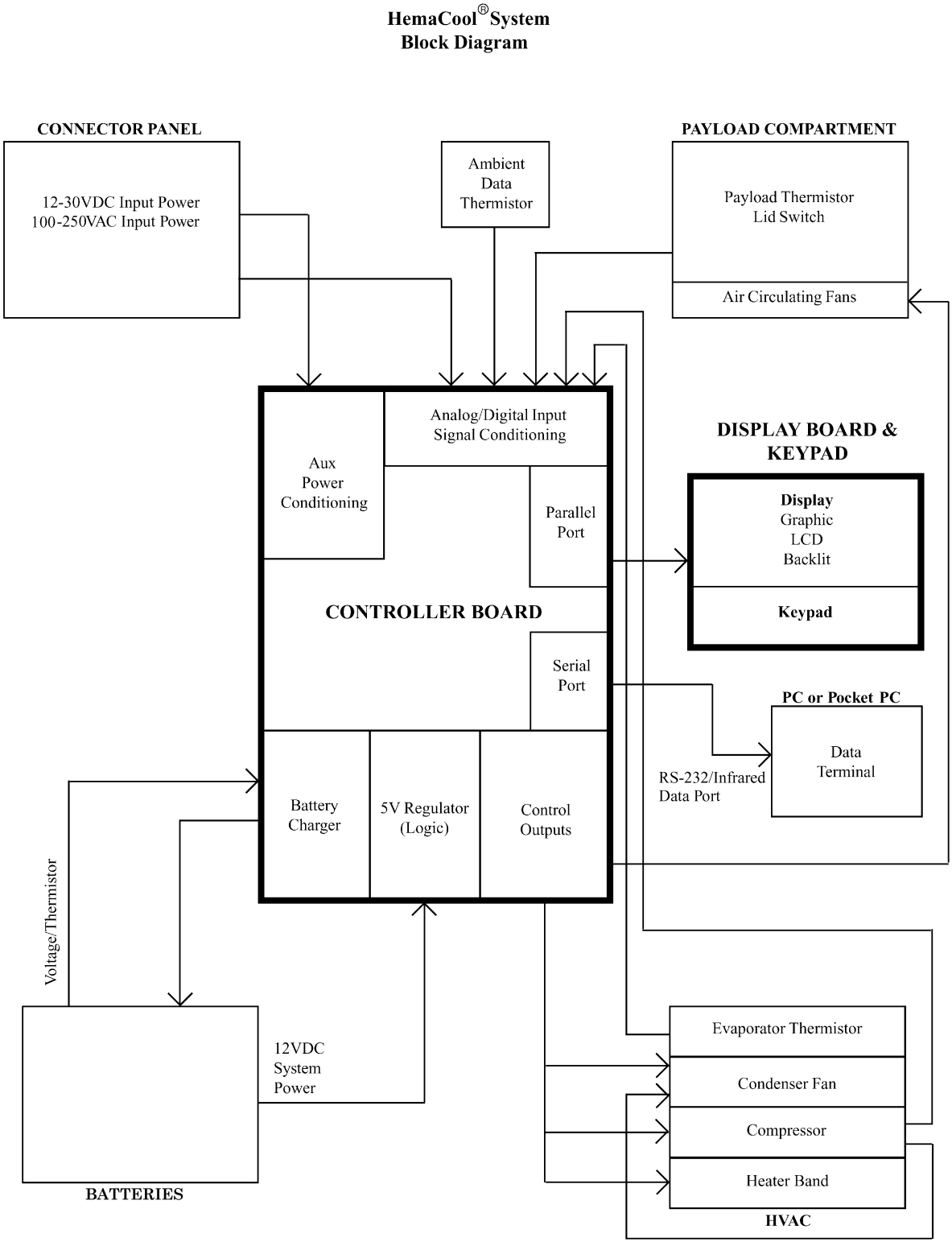


Figure 1-2. Functional Block Diagram

Section II. Operator Controls and Displays

1-6. POWER PANEL

The power panel (Figure 1-3) in the compressor and electronics compartment has input connectors for auxiliary DC power and for an AC power cord. The AC power connector is fused by two fuses on this panel. Two fuses are employed because the unit will operate on either 115 VAC or 230 VAC. Operation on 230 VAC requires both non-ground leads to be fused.

ITEM	DESCRIPTION	FUNCTION
1	AC Power Source Connector	Connection to AC external power sources
2	DC Power Connector	Connection to DC power sources
3	Line Fuses	Operator replaceable overload protection

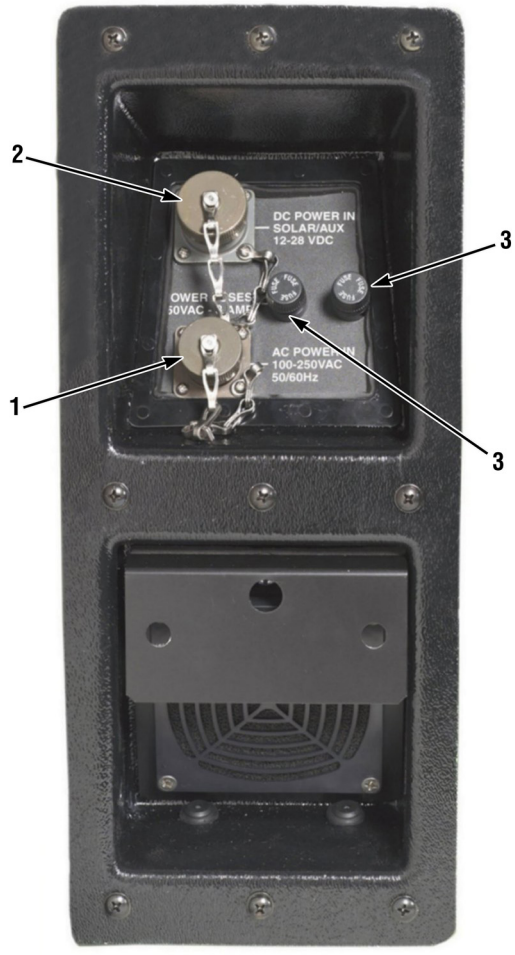


Figure 1-3. Power Panel

1-7. DISPLAY AND CONTROL PANEL

The display and control panel (Figure 1-4) contains the LCD and LED displays and operator controls. The panel also includes the infrared communication port device (IrDA standard) and RS-232 serial port for the data logger.

ITEM	DESCRIPTION	FUNCTION
1	Multifunction LCD Display	Displays detailed information on a number of operating parameters, and when compressor is off, the display shows IDLE.
2	Temperature LED	Indicates payload compartment temperature in or out of the selected range
3	Battery LED	Indicates a charge condition of the internal 12 VDC batteries
4	RS-232 Data port	Download of data logging information
5	IR (infrared) Port	Download of data logging information
6	DISPLAY Key	Changes LCD display screen function, displays history graph information, and when used in conjunction with MODE button, changes operation between COOL and FREEZE
7	MODE Key	Used in conjunction with DISPLAY button to change operation between COOL and FREEZE, toggles the display information and diagnostic pages, and when used in conjunction with the ON/OFF key, sets the time and date
8	ON/OFF Key	Starts and shuts down unit, and when used in conjunction with the MODE key, sets the time and date

Figure 1-4. Display and Control Panel

1-8. DISPLAYS AND ALERTS

Information on the status of the HemaCool® is presented on a display panel (Figure 1-4), which employs two light emitting diodes (LED) and a liquid crystal display (LCD) that includes four rows of text.

a. LEDS

Two multicolored LED indicators provide temperature and battery status alarms. The temperature LED (on the left) shows GREEN when the temperature is in the selected range and RED when it is outside that range. In the COOL mode, it will also turn YELLOW, when the unit is switching between compressor and heater operation. This happens if the ambient temperature drops below or rises above 0°C (32°F) of the control temperature. The battery status LED (on the right) shows GREEN when the battery has 10 percent or more of charge, YELLOW when it has less than 10 percent of charge, and RED when the charge nears 0 percent. When the unit is operated on AC power, the battery status (right LED) should always illuminate GREEN or change to GREEN within a few minutes as the internal battery recharges.

b. Temperature LED indicators

The tables below show the exact temperatures and voltages that trigger the LED color changes for different set points.

(1) Temperatures for COOL mode.

LED COLOR	PAYLOAD SPACE TEMPERATURE
GREEN	Between 1.0°C (34°F) and 6.0°C (43°F)
RED	1.0°C (34°F) or below or 6.0°C (43°F) and above

(2) Temperatures for FREEZE mode.

LED COLOR	PAYLOAD SPACE TEMPERATURE
GREEN	Below -20°C (-4°F)
RED	-20°C (-4°F) or above

c. Battery Voltage LED Indicators

The tables below show the exact voltages that trigger the LED color changes:

LED COLOR	BATTERY VOLTAGE
GREEN	11.8 V and above
YELLOW	Between 11.5 V and 11.8 V
RED	11.5 V and below

1-9. AUDIBLE ALARM

a. The HemaCool® has an audible alarm. The alarm sounds only when the unit is operating on AC power and is set from COOL mode to FREEZE mode or vice versa. The alarm continues to sound until the unit reaches temperature range. The alarm also sounds when a RED alarm condition occurs. A RED alarm condition occurs when temperature or battery voltage is outside its nominal operating range.

b. The alarm sounds three times at 1-second intervals in a cycle that recurs every 18 seconds. The alarm indicates that the payload is not at required temperature and needs attention.

c. Typically, this means attaching a different applicable/available power source to maintain unit operation while simultaneously charging its internal batteries.

1-10. KEYS

NOTE

The LCD backlight comes on in response to any key activity and stays on for 30 seconds after the last key activity.

a. The ON/OFF key has two functions. It is used to turn the HemaCool® on or off and, when used in conjunction with the MODE key, sets the date and time.

(1) To turn the HemaCool® on or off, press and hold the ON/OFF key for 2 seconds.

NOTE

The date and time can only be set when the unit is powered by AC and idle.

(2) To set the date and time, ensure the system is powered by AC and idle, then press and hold the ON/OFF and MODE keys simultaneously, then follow displayed text instructions.

b. The DISPLAY key has three functions. It is used to change the LCD displayed screen function, displays history graph information, and when used in conjunction with the MODE key, changes the temperature mode selection of COOL or FREEZE.

(1) To change the displayed screen function, press the DISPLAY key once.

(2) To display the history graph function, press the DISPLAY key twice.

(3) To alternate between COOL and FREEZE temperature modes, simultaneously press the DISPLAY and MODE keys.

c. The MODE key has three functions. When used in conjunction with the DISPLAY key, the MODE key changes the temperature mode selection of COOL or FREEZE. It is also used to toggle the display information and diagnostic pages. When used in conjunction with the ON/OFF key, the MODE key sets the date and time.

(1) To alternate between COOL and FREEZE temperature modes, simultaneously press the MODE and DISPLAY keys.

(2) To toggle the display information and diagnostic pages, press and hold the MODE key for 3 seconds.

(3) To set the date and time (only works when system is idle and running on AC power), simultaneously press and hold the ON/OFF and MODE keys. Follow displayed text instructions.

1-11. LCD DISPLAY

The LCD display includes four rows of text in three information pages and two diagnostic pages.

a. Information Page 1 displays current status. Figure 1-5 shows how current status information is displayed on the LCD display.

(1) The top row shows:

(a) Payload temperature from -30.0°C (-22°F) to 50.0°C (122°F).

(b) Payload temperature status (HIGH/LOW/OK).

(2) The second row shows:

(a) Battery charge state as a percentage.

(b) External power, if AC or AUX DC input connected.

(3) Reading from left to right, the third row of text shows:

(a) The current operating mode (COOL/FREEZE/IDLE).

(b) The current activity (COMP ON/HEAT ON) (Comp = Compressor).

(4) The fourth line shows both:

(a) The current date.

(b) The current time.

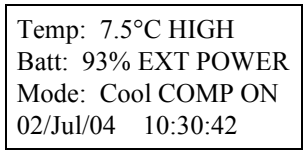


Figure 1-5. Information Page 1, LCD Display Current Status

b. Information Page 2 displays the maximum and minimum temperatures for the post of operation. Figure 1-6 shows how minimum and maximum temperature information is displayed on the LCD.

(1) The top row displays the maximum temperature within viewed data.

(2) The second row displays the date and time when the maximum temperature was first detected.

(3) The third line displays the minimum temperature detected within viewed data.

(4) The fourth line displays the date and time when the minimum temperature was first detected.

NOTE

These values are from within the span of data viewed in the history graph on Information page 3; the total time span can be set by the operator.

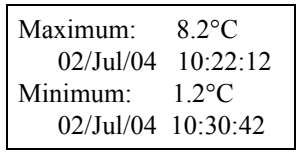


Figure 1-6. Information Page 2, LCD Minimum and Maximum Temperature Display

c. Information Page 3 displays a history graph of temperature over time. Figure 1-7 shows how the history graph information is displayed on the LCD display.

(1) The top left row displays maximum temperature within the displayed history.

(2) The second left row displays the midpoint temperature within the displayed history.

(3) The third left row displays the minimum temperature within the displayed history.

(4) The fourth row displays the time scale for the history being shown.

(5) The time scale shown starts at 0-24 hours. Each time the graph reaches the right edge, it rescales to the next scale. Additional scales are 0-48 hours, 0-7 days, 0-14 days, and 0-30 days. In each case, the graph shows the most recent data.

(6) Once the scale reaches the 0-30 day scale, and the graph area is filled, new data continues to scroll in and the oldest data is lost.

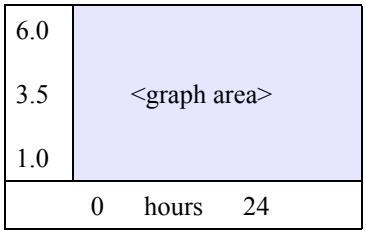


Figure 1-7. Information Page 3, LCD History Graph Display

(7) A vertical line is drawn on each row indicating the range of temperatures included for that time period. Each horizontal position represents a given period of time, depending on the time scale. See the table below.

Time Scale	Time Period Per Horizontal Position (hh:mm)
0-24 hours	00:20
0-48 hours	00:40
0-7 days	02:20
0-14 days	04:40
0-30 days	10:00

NOTE

If a large amount of data has been collected, the unit might require up to several minutes to complete the rescale.

(8) To change the time span, the unit must be **Idle** with AC power connected. Press and hold the DISPLAY key for 3 seconds, then follow the prompts.

d. Diagnostic Page 1 displays charge control status. Figure 1-8 shows how charge control diagnostics information is displayed on the LCD.

(1) The top row displays:

(a) The current level of battery charge as a percentage.

(b) The LMD register.

(2) The second row displays:

(a) The FLGS1 register.

(b) The FLGS2 register.

(3) The third row displays:

(a) The NACH register.

(b) The NACL register.

NOTE

Register values are shown in hex.

(4) The fourth row displays:

(a) Charge status.

(b) Input levels.

NOTE

Input levels are:

- L for Logic 0
- H for Logic 1
- * for Pulsing

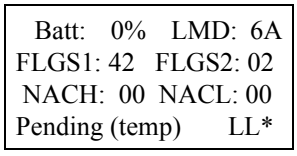


Figure 1-8. Diagnostic Page 1, LCD Charge Control Diagnostics

e. Diagnostic Page 2 displays cooling system control status. Figure 1-9 shows how cooling diagnostic information is displayed on the LCD.

(1) The top row displays:

(a) Revision date.

(b) Serial number.

(c) Keys.

(d) Lid switch.

(2) The second row displays:

(a) Payload temperature.

(b) Evaporator temperature.

(3) The third row displays:

(a) Ambient temperature.

(b) Battery voltage.

(4) The fourth row displays:

(a) Control activity.

(b) Activity time.

1 The compressor can operate in either slow or fast speed. Each time the compressor is started, it runs in slow speed. If the compressor runs continuously for 2 minutes, and the temperature still has not reached the desired target, the compressor switches to fast speed. It continues to run in fast speed until it is turned off. The display will show COMP, indicating compressor is running at slow speed, or the display will show COMP F, indicating compressor is running at fast speed. The display will also show COMP ON time *nn,* where *nn* is the number seconds the compressor has been running on slow speed.

2 When the compressor is started, it always runs for at least 30 seconds at slow speed, unless the controller switches to low power (e.g., switched to idle while running on batteries) or the evaporator temperature drops below freezing while in cooling mode. During the initial 30 seconds of run time, the display will show COMP Starting *nn,* where *nn* is the number of seconds remaining in the 30-second minimum time.

3 When the compressor is stopped, it remains off for at least 60 seconds. During the initial 60 seconds of off time, the display will show COMP Stopping *nn,* where *nn*, is the number of seconds remaining in the 60-second minimum time.

4 When the heater operates to prevent payload freezing in outside ambient temperatures of below 0°C (32°F), the display will show HEAT.

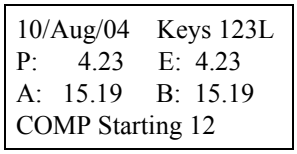


Figure 1-9. Diagnostic Page 2, LCD Cooling System Diagnostics

1-12. BATTERY STATUS AND CHARGING

The battery charge level, shown on Information Page 1 of the display (and on Diagnostic Page 1), indicates the remaining battery capacity.

a. Initial Operation

(1) To achieve an accurate measure, the internal "gas gauge" records the amount of charge applied to the batteries and the amount of power pulsed from the batteries by the HemaCool® system.

(2) After initial connection of new batteries, the charge level is unknown and is shown as 0%.

(3) After the unit has cycled through a complete discharge and charge cycle, the level is very accurate, and the accuracy continues to improve as additional cycles are observed.

(4) Even if the level shows 0%, as long as there is charge remaining in the batteries, the system will continue to operate.

b. Discharged Batteries

(1) When the batteries become fully discharged, the unit switches to a low power mode and will not operate until an external AC or DC power source is connected.

(2) If AC power is applied, the display is activated with control IDLE. The ON/OFF button can then be used to start the cooling or freezing operation.

(3) If DC power is applied, the system remains off, but responds to the ON/OFF button, allowing operation to be started. Note that it may take 30 seconds after connection of DC power before the ON/OFF key will respond.

c. Failed or Missing Batteries

(1) If the batteries are faulty (i.e., cannot be charged) or disconnected, and AUX DC power is applied, the LCD display will not turn on, but the battery and/or temperature LEDs will flash. The beeper may also sound.

(2) Even in this case, the unit will operate when AC power is connected.

(3) To confirm this condition, connect AC power; the LCD then turns on, and Diagnostics Page 1 indicates "Battery absent" or "**Fault**".

1-13. CHARGE STATUS

The fourth row of Diagnostic Page 1 indicates the current charging status. The possible messages include:

BOTTOM LINE DISPLAY	DEFINITION
Pre-charge qual	The charge controller is checking the battery to determine whether it is able to accept a charge (e.g., no open or shorted cells).
Battery absent	No battery was detected by the charge controller.
Fast charge curr	The battery is charging in the first of two fast charge modes (using current to control charge).
Fast charge volt	The battery is charging in the second of two fast charge modes (using voltage to control the charge).
Maint charge	The battery has been fully charged, and the charge controller is maintaining it at 100 percent capacity.
Pending (temp)	The charge controller is waiting for the battery temperature to enter valid range before starting the charge sequence.
** FAULT **	The charge controller has detected a battery fault (e.g., open or shorted cell) and cannot attempt to charge.
No ext power	No external power is available to use for charging.
Invalid state	The charge controller is switching between charge states.

1-14. CONTROL MODES

The HemaCool® operates in two different control modes. One is the temperature alarm mode and the second is the control logic mode. The temperature alarm mode notifies the user of payload temperatures by displaying status on both the temperature LED and on Information Page 1 (current status), line 1. The control logic mode will indicate on Information Page 1 (current status), line 3, if the unit is in the heating or cooling mode and if the compressor is allowed to operate.

a. Cooling Mode Temperature Alarm

(1) When payload is between 1.0ºC (33.8°F) and 6.0ºC (42.8°F), OK will appear on the LCD and the GREEN temperature LED will be illuminated.

(2) When payload is at or below 1.0ºC (33.8°F), LOW will appear on the LCD and the RED temperature LED will be illuminated.

(3) When payload is at or above 6.0ºC (42.8° F), HIGH will appear on the LCD and the RED temperature LED will be illuminated.

b. Cooling Mode Control Logic

(1) When either heating or cooling, the unit will start heating when the payload is below 2.0ºC (35.6°F), the evaporator is below 1.0°C (33.8°F), and HEAT will appear on Information Page 1 (current status), line 3.

(2) When either heating or cooling, the unit will start cooling when the payload is above 4.0 ºC (39.2°F), the evaporator is above 3.0ºC (37.4°F), and COOL will appear on Information Page 1 (current status), line 3.

(3) When heating, the unit will stop heating when the payload is above 4.0ºC (39.2°F) or the evaporator is above 4.0ºC (39.2°F); HEAT will appear on Information Page 1 (current status), line 3.

(4) When cooling, the unit will stop cooling when the payload is below 2.0ºC (35.6°F) or the evaporator is below 1.0ºC (33.8°F).

(5) When cooling, the unit will stop the compressor immediately, if the evaporator is below 0ºC (32°F).

c. Freezing Mode Temperature Alarm

(1) When the payload is below -20.2°C (4.4°F), OK will appear on the LCD and the GREEN temperature LED will be illuminated.

(2) When the payload is above -20.2°C (4.4°F), HIGH will appear on the LCD and the RED LED will be illuminated.

d. Freezing Mode Control Logic

(1) When the evaporator is at or above -24.0ºC (-11.2°F), control logic will turn the compressor on.

(2) When the evaporator is at or below -26.0ºC (-14.8°F), control logic will turn the compressor off.

1-15. POWER STATES

a. Depending on the connections and battery charge level, there are three possible states for the controller:

STATE	DESCRIPTION
External Power	AC or AUX DC power is connected
Battery Power	External Power disconnected, battery charge okay
Discharged	External Power disconnected, battery discharged

NOTE

Since the LCD is always on when external power is applied, it serves as verification that the external power input is connected.

b. Low Power

(1) Whenever the LCD is off, the controller is in a low power mode. Most power-consuming devices are switched off, and the CPU is kept in a low power standby mode.

(2) In the DC power state, the controller wakes up and activates the LCD display, if AC power is applied or control is started (via the ON/OFF key).

(3) In the discharged state, the controller is kept in a low power mode, and does not respond to key activity. If control (cooling or freezing) is active when discharged state is entered, the controller wakes up every 5 minutes to take a sample from the ADC channels, so that it can create a log entry.

c. Various operations are affected by the power state as shown in the table below:

NOTE

The battery LED flashes every 4 seconds and the beeper sounds every 18 seconds, if temperature is out of range

	External power		Battery power		Discharged
	Control on	Control off	Control on	Control off	
LCD	On	On	On	Off	Off
Temp LED	Flashing	Off	Flashing	Off	Off
Batt LED	Flashing	Flashing	Flashing	Off	Off
Beeper	On	Off	Off	Off	Off

d. Battery Level LED. The battery level indicator LED (when active - see chart above) changes color to indicate level:

(1) Green: Battery level above 15%

(2) Yellow: Battery level between 10% and 15%

(3) RED: Battery level below 10%

1-16. LOGGING

a. Whenever the Cooling or Freezing control operation is active, an entry is added to the EEPROM-based log every 5 minutes.

Each log entry includes:
- Payload temperature
- Ambient temperature
- Battery charge level
- Battery voltage
- Status, which includes:
  - o Operating or idle
  - o Cool or Freeze mode
  - o Compressor on/off
  - o Heater on/off
  - o Lid open/closed (reports open if lid was opened at any time during previous 5 minutes)

b. The log can hold up to 30 days of data. If logging continues for more than 30 days, the oldest entry is discarded each time a new entry is added, so that the log always contains the most recent 30-day period.

c. If during active control operation (cooling or freezing), the main battery becomes discharged and logging continues until the battery power is restored (or AC power connected).

d. Log can be retrieved via the serial or IR ports.

1-17. SERIAL/IR PORTS

a. Commands format.

(1) The following commands are supported on either the DATA PORT (RS-232) or IR DATA PORT.

(2) The ports are only available for use when the LCD display is on (anytime AC power is connected or on DC power when control is active).

1-18. HEMALOG PROGRAM

The HemaCool® is equipped with a data logging system. This system monitors the payload temperature, ambient temperature, and the main battery voltage. The data log may be downloaded by IrDA link into a Pocket PC (PPC) computer employing the windows CE operating system. This produces a text file that may be imported into a spreadsheet program for graphing.

a. Installation

(1) Place the Pocket PC device in its cradle and make sure it is connected to the desktop.

(2) Insert the HemaLog CD into the CD-ROM drive. The installation should begin automatically. If not, open Windows Explorer and double-click "HemaLogInstall.exe".

(3) The installation will check for the .NET Framework v1.1. If it has not been previously installed, the installer will attempt to do so. NOTE: HemaLog-PC requires version 1.1. If version 1.0 only exists, then the installer will still add version 1.1 to the system.

(4) After ensuring the existence of the .NET Framework v1.1, the HemaLog Setup Wizard will open. The user can then choose to install Hemalog-PC and/or HemaLog/CE. If the Pocket PC does not have .NET Compact Framework v1.0 installed, the setup will install it.

(5) Before HemaLog-CE will function properly on a Pocket PC, the automatic detect and connect feature for IR port must be turned off. To do this:

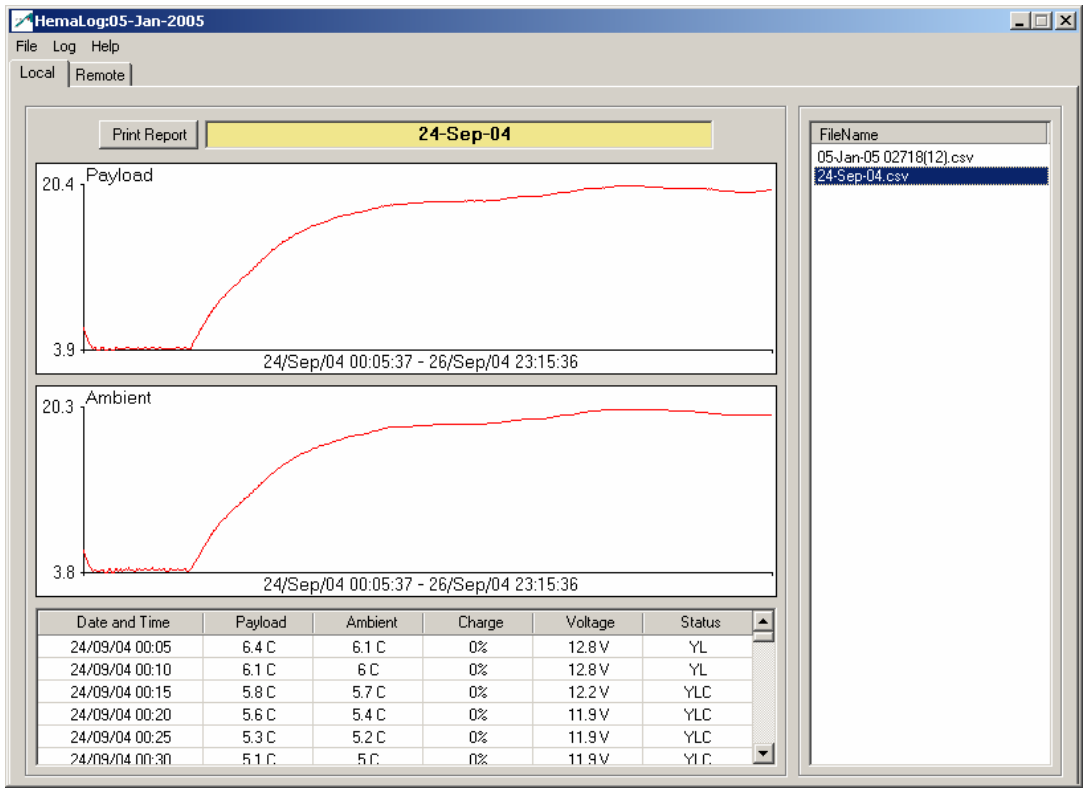
(a) Tap the Start button and select Settings

(b) Tap the Connections tab and select the Beam icon

(c) Make sure the check box is unchecked

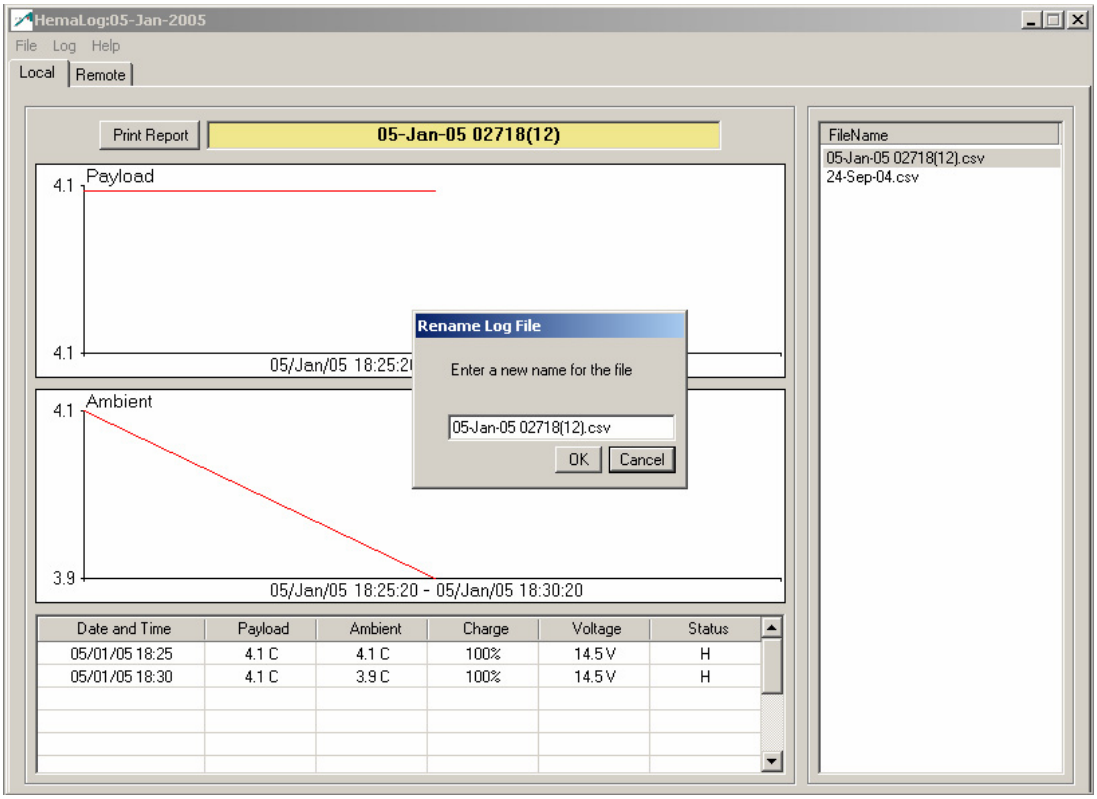
b. Operation-HemaLog

At startup, HemaLog starts on the Local tab with no data selected. To view a previously stored log, click on its name shown in the list on the right-hand side. Once selected, date/time ranges of the file, graphs representing the payload and ambients temperatures over time, and a table with all significant values stored in the log are displayed.

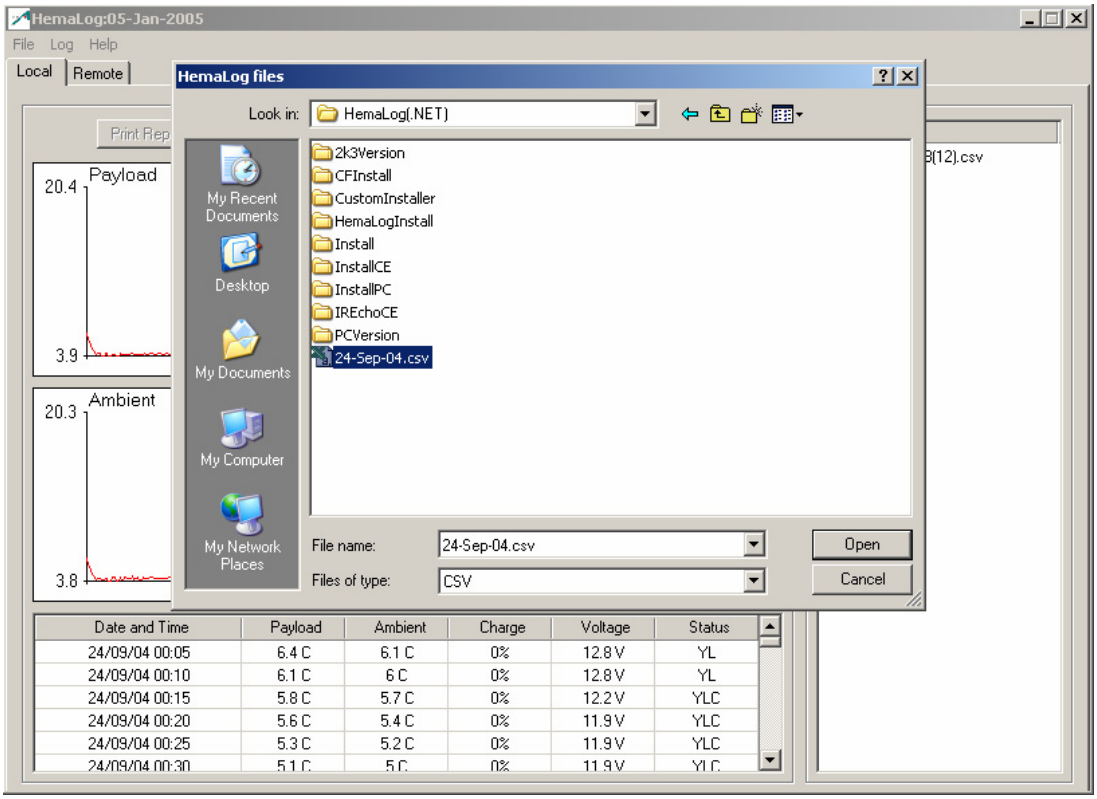


Date and Time	Payload	Ambient	Charge	Voltage	Status
24/09/04 00:05	6.4 C	6.1 C	0%	12.8 V	YL
24/09/04 00:10	6.1 C	6 C	0%	12.8 V	YL
24/09/04 00:15	5.8 C	5.7 C	0%	12.2 V	YLC
24/09/04 00:20	5.6 C	5.4 C	0%	11.9 V	YLC
24/09/04 00:25	5.3 C	5.2 C	0%	11.9 V	YLC
24/09/04 00:30	5.1 C	5 C	0%	11.9 V	YLC

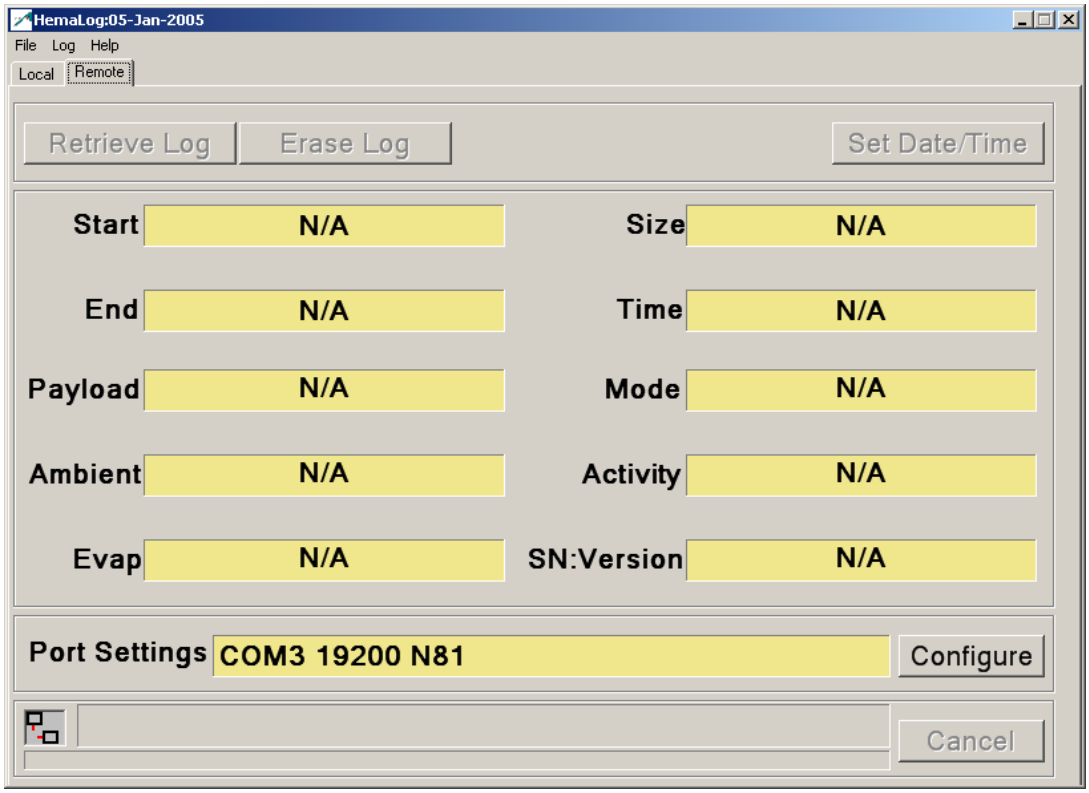
Log files retrieved from a HemaCool® unit are assigned a default name automatically by HemaLog-PC. In order to rename the file, first select it by clicking on its name in the list. Then either right-click and select Rename or click on Log at the menu bar and select Rename; a popup window will be shown displaying the old name for the file and asking the user to enter a new name. A user can click OK to accept the new name or cancel to discard it and keep the original. Similarly a log can be deleted. Select Delete from one of the two menus. A popup will be shown asking the user to confirm the decision to delete the file.



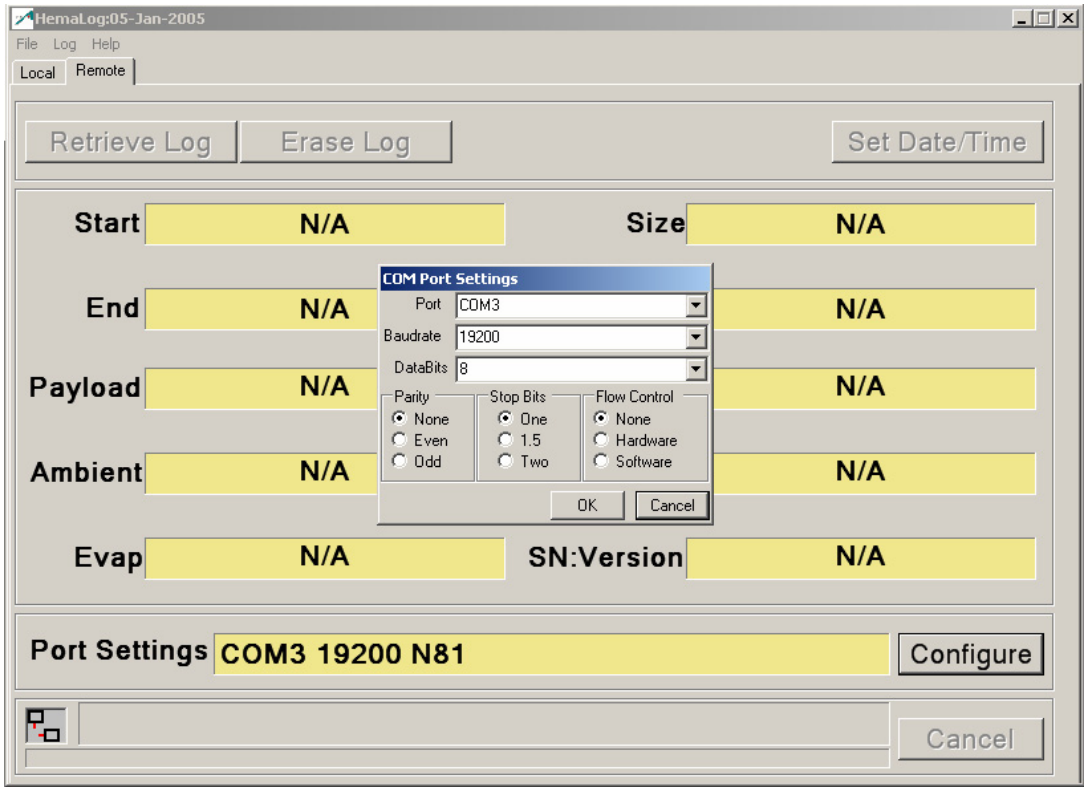
In order to import a log file to the HemaLog system, either access the Log menu from the Menu bar or right click on a file and select "Load From" option. A dialog will open prompting the user to choose a .csv file. A log file can also be exported by choosing the "Save To" option from the menu. Selecting "Browse" opens a Windows Explorer to the log storage folder.



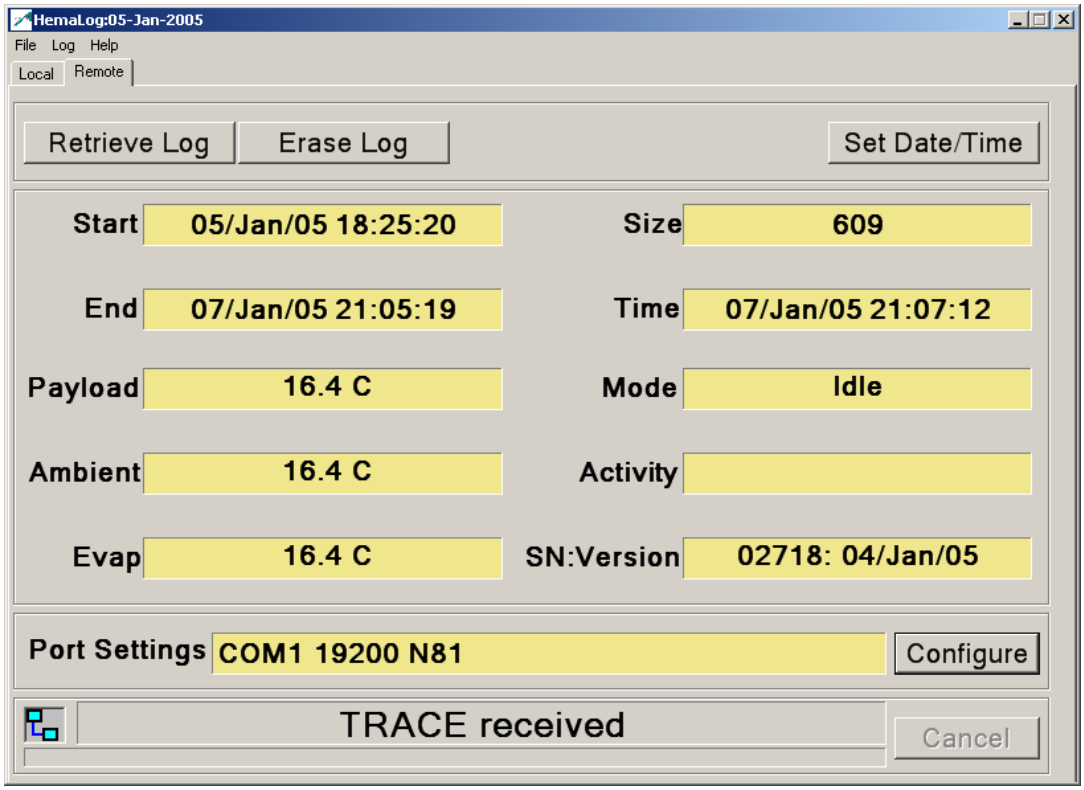
Also at startup, HemaLog-PC attempts to connect to a HemaCool® unit. If the connection fails (either no physical link at startup or link broken during operation), HemaLog-PC periodically tries to reconnect. The status of the connection is shown by the icon in the lower left corner of the Remote page.



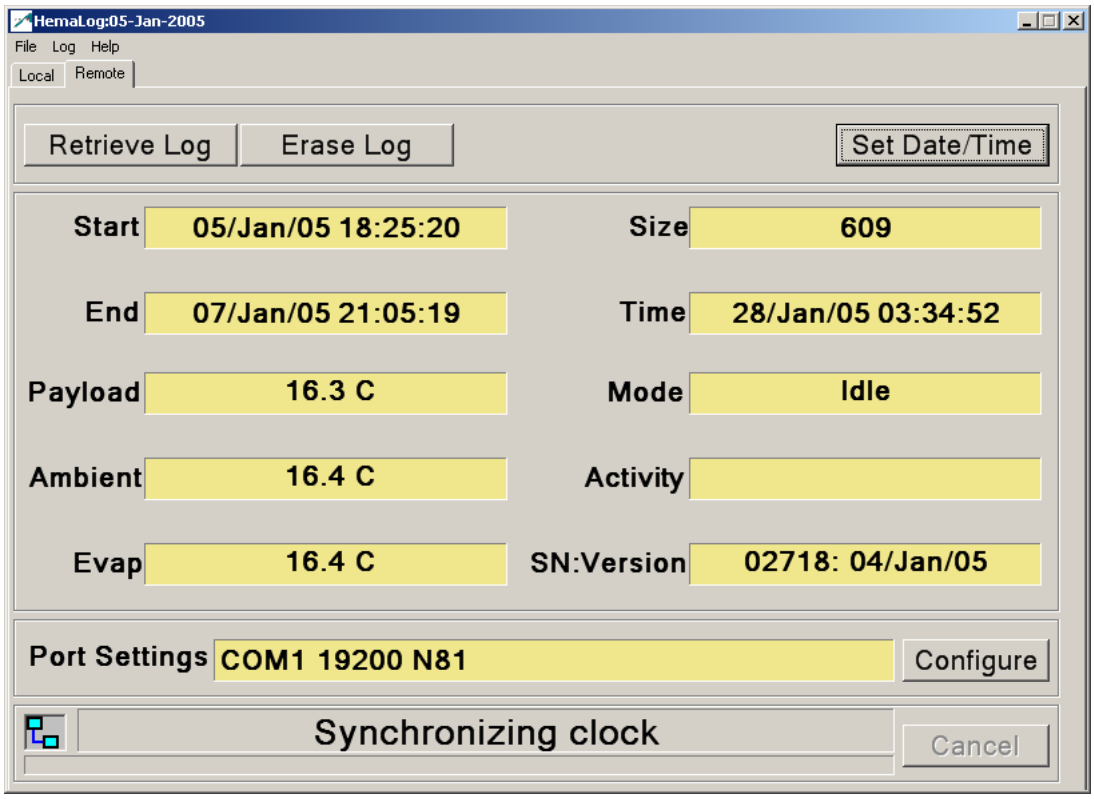
The port used for communication can be changed by clicking on the Configure button in the Port Settings section.



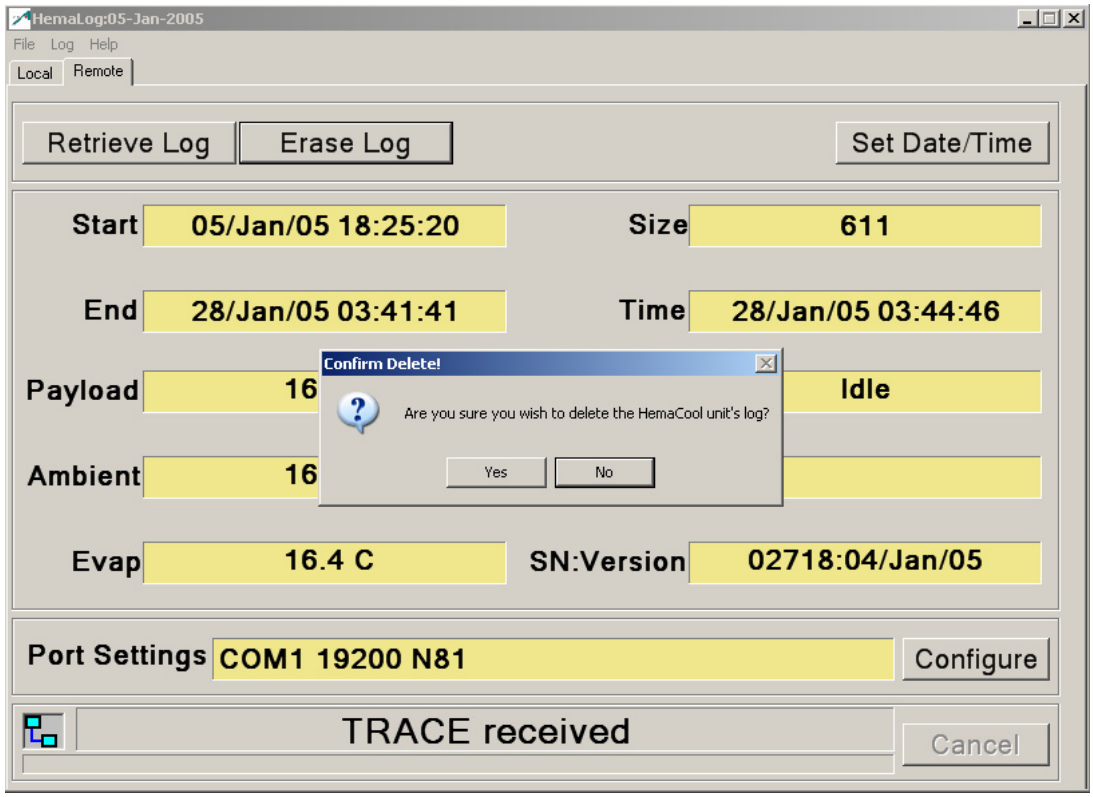
Once HemaLog-PC is connected to a HemaCool® unit, HemaLog-PC begins receiving diagnostic information from the unit. The Start, End, and Size values refer to the HemaCool® unit's log, while Time, Payload, Mode, Ambient, Activity, Evap, and Version values represent current conditions of the unit. Also the Retrieve Log, Erase Log, Set Date/Time buttons and the Update Firmware option in the File menu all become clickable.



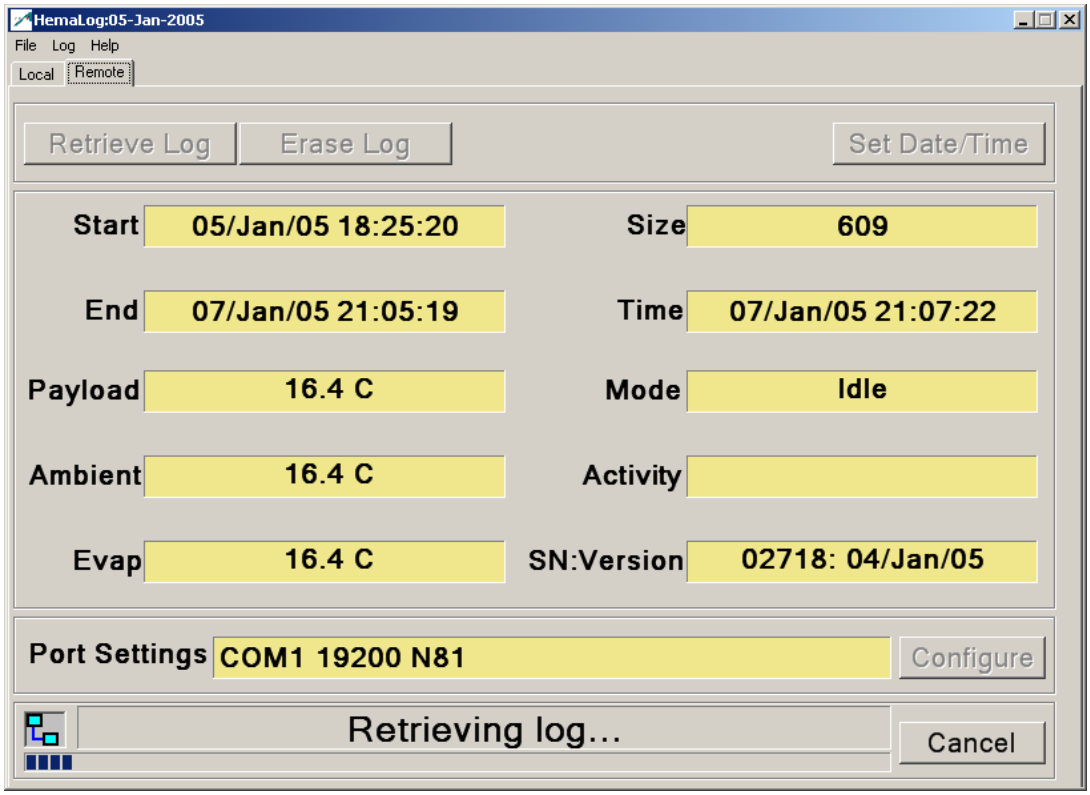
Clicking Set/Date Time synchronizes the HemaCool® unit's date and time with the machine running HemaLog-PC.



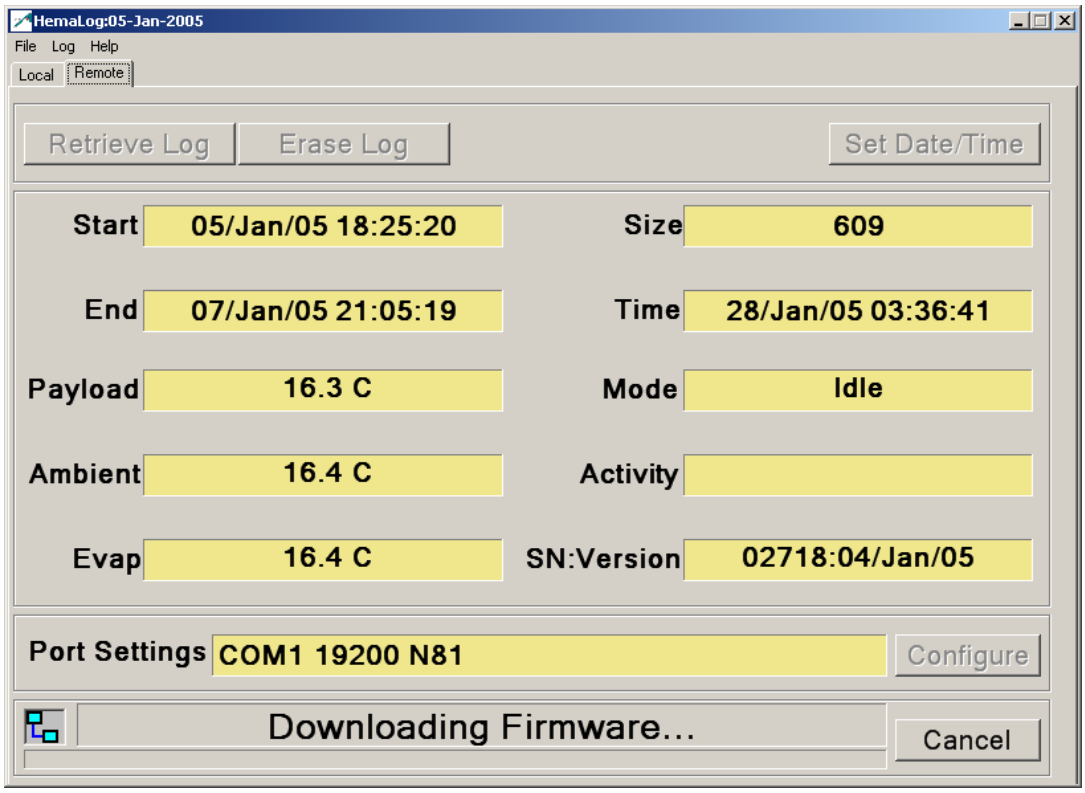
If the user clicks Erase Log, a popup will be shown to confirm clearing the log. After HemaCool® has cleared its log, then HemaLog-PC will update the Start, End, and Size values.



When the user clicks Retrieve Log, HemaLog-PC will automatically download the HemaCool® unit's log data, create a filename, and add the file to list shown on the Local page.



The firmware on a HemaCool® unit can be changed by clicking on File->Update Firmware. A dialog will be shown asking the user to select a file with the firmware. After choosing the file, the update will proceed automatically.



c. Operation - HemaLog-CE

On startup, HemaLog-CE loads a list of previously stored logs, opens the first log in the list, and displays the date/ time range and graphs of the payload and ambient temperatures.

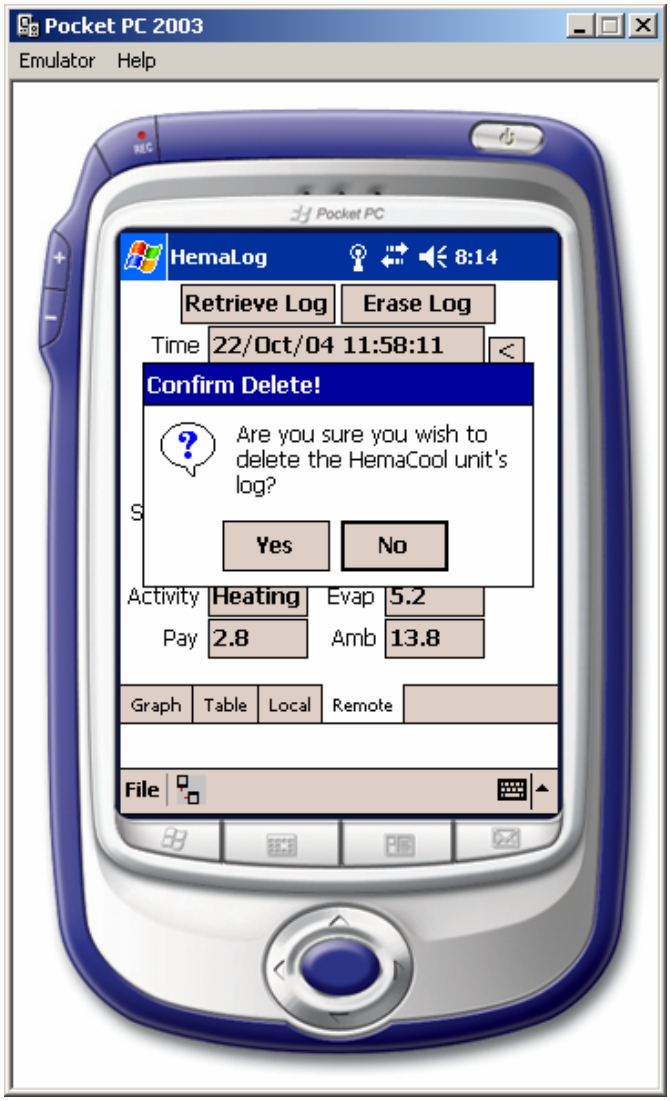
The user can also see a tabular representation of the data by clicking on the data table.

Log files retrieved from a HemaCool® unit are assigned a default name automatically by HemaLog-CE. In order to rename the file, first click on the Local tab and click on the file you want to rename in the list. Then click the Rename button; a popup window will be shown displaying the old name for the file and asking the user to enter a new name. A user can click OK to accept the new name or cancel to discard it and keep the original. Similarly, a log can be deleted by clicking on the name in the list and then clicking the Delete button. A popup will be shown asking the user to confirm the decision to delete the file.

Also at startup, HemaLog-CE attempts to establish a connection with a HemaCool® unit via the IR port. If the connection fails (the Pocket PC IR port is not pointed at a HemaCool® unit's IR port), HemaLog-CE periodically tries to reconnect. The status of connection is shown by the icon in the lower left corner of the menu bar. Once HemaLog-CE is connected to a HemaCool® unit, HemaLog-CE begins receiving diagnostic information from the unit. The Size, End and Start values refer to the HemaCool® unit's log, while Time, Payload, Mode, Evap Ambient, Activity, and Version values represent current conditions of the unit. Also the Retrieve Log, Erase Log, Set Date/Time buttons and the Update Firmware option in the File menu all become clickable.

Clicking Set/Date Time synchronizes the HemaCool® unit's date and time with the Pocket PC running HemaLog-CE.

If the user clicks Erase Log, a popup will be shown to confirm the clearing of the log. After HemaCool® has cleared its log, then HemaLog-CE will update the Start, End, and Size values.



When the user clicks Retrieve Log, HemaLog-CE will automatically download the HemaCool® unit's log data, create a filename, and add the file to a list shown on the Local page.

CHAPTER 2. OPERATION

2-1. SAFETY AND PRECAUTIONS

a. Warnings:

WARNING

- THE HEMACOOL® UNIT WEIGHS 142 LBS (64.5 KGS) EMPTY AND UP TO 180 LBS (81.7 KGS) LOADED. ALWAYS USE AT LEAST TWO PEOPLE WHEN LIFTING OR MOVING THE UNIT TO PREVENT PERSONAL INJURY.
- DISCONNECT ALL EXTERNAL POWER SOURCES BEFORE CONNECTING OR DISCONNECTING BATTERIES. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.
- DISCONNECT ALL EXTERNAL POWER SOURCES. REMOVE THE CASE LID THEN REMOVE THE COVER PANEL AND DISCONNECT BATTERIES BEFORE PERFORMING MAINTENANCE OR SERVICE. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.

b. Cautions:

CAUTION

- Use the cool (4.0 ±1°C (39.2° ±2°F)) temperature setting only with materials that must be stored above freezing.
- Use the freeze (-22 +0/-6°C (-7 +0/-11°F)) temperature setting only for materials that must be stored frozen.
- If the unit is stored inverted or on its side, allow it to sit upright at least 2 hours before operating.
- Do not tilt the unit over 30° while operating.
- For maximum efficiency, do not tilt the unit at all during operation.
- Do not store the unit in ambient temperatures below -30°C (-22°F) or over 65°C (149°F).
- Do not operate the unit in the refrigerator mode in ambient temperatures below -20°C (-4°F) or above 49°C (120°F). Do not transport the unit without the outer lid in place and all inner lid and outer lid latches closed.
- During operation, the unit must not be situated so that air inlets or outlets are blocked or obstructed. The refrigeration system must be able to release heat to cool the payload properly.
- The unit should not be operated in a small, non-ventilated area. The refrigeration system must be able to release heat to cool the payload properly.
- Do not submerge the unit in water.

- Do not sit or stand on the unit.
- HemaCool® units may be safely stacked no more than two units high.

2-2. EQUIPMENT CARE

a. The HemaCool® is a ruggedized system built to military specifications, but care should be taken in its use and operation. The following steps should be taken to ensure proper operation and long life.

(1) Keep air filter screens on the case clean and free of debris.

(2) Do not store or situate the unit in vehicles or structures so that air filter screens are blocked or obstructed.

(3) Keep gasket and sealing surfaces clean and free of debris.

2-3. HANDLING

a. Unpacking and readying the HemaCool® for operation:

WARNING

- THE HEMACOOL® UNIT WEIGHS 142 LBS (64.5 KGS) EMPTY AND UP TO 180 LBS (81.7 KGS) LOADED. ALWAYS USE AT LEAST TWO PEOPLE WHEN LIFTING OR MOVING THE UNIT TO PREVENT PERSONAL INJURY.
- DISCONNECT ALL EXTERNAL POWER SOURCES BEFORE CONNECTING OR DISCONNECTING BATTERIES. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.
- DISCONNECT ALL EXTERNAL POWER SOURCES. REMOVE THE CASE LID THEN REMOVE THE COVER PANEL AND DISCONNECT BATTERIES BEFORE PERFORMING MAINTENANCE OR SERVICE. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.

(1) Remove the HemaCool® from its crating materials.

(2) Unlatch the outer lid. This lid has 10 latches, one on each side, four on the front, and four on the back (Figure 2-1).

(3) Flip out and rotate the key tabs on each latch until each latch claw has released its hasp.

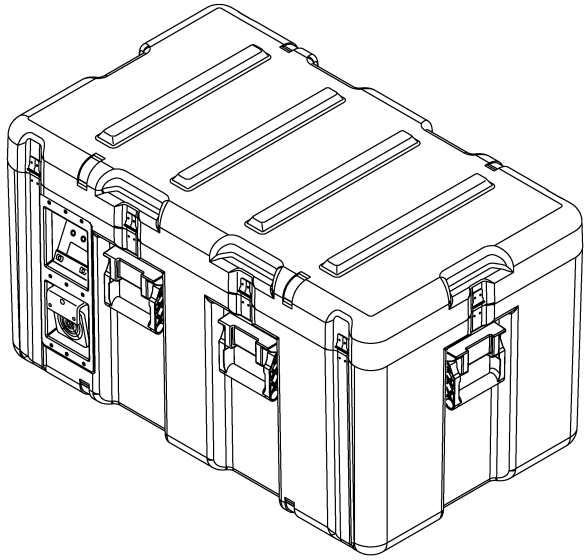


Figure 2-1. HemaCool® Outer Lid Latches

(4) Remove the power cord from the cover panel.

(5) Open the inner lid to access payload storage (Figure 2-2).

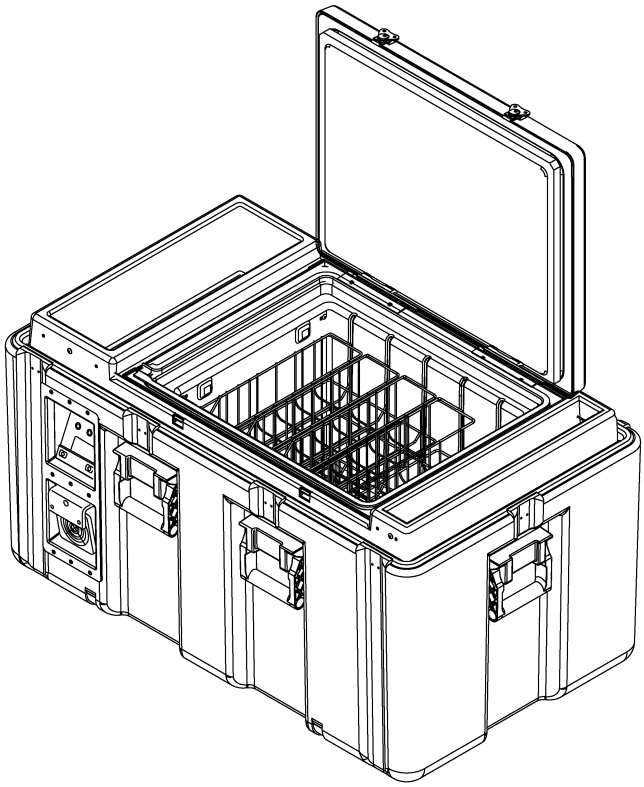


Figure 2-2. HemaCool® Interior

2-4. STARTUP PROCEDURES

WARNING

- THE HEMACOOL® UNIT WEIGHS 142 LBS (64.5 KGS) EMPTY AND UP TO 180 LBS (81.7 KGS) LOADED. ALWAYS USE AT LEAST TWO PEOPLE WHEN LIFTING OR MOVING THE UNIT TO PREVENT PERSONAL INJURY.
- DISCONNECT ALL EXTERNAL POWER SOURCES BEFORE CONNECTING OR DISCONNECTING BATTERIES. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.
- DISCONNECT ALL EXTERNAL POWER SOURCES. REMOVE THE CASE LID THEN REMOVE THE COVER PANEL AND DISCONNECT BATTERIES BEFORE PERFORMING MAINTENANCE OR SERVICE. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.

a. The HemaCool® is shipped with its internal batteries disconnected. Before initial use, the batteries must be connected as follows:

(1) Remove the contents from the cover panel.

(2) Remove the eight screws that hold the cover panel in place and remove the cover (Figure 2-3).

(3) Connect the battery power harness to the fusible link assembly (Figure 2-4).

(4) If the display is blank, complete the following steps:

(a) Remove the retaining clip and the 3.6 volt lithium battery from the control motherboard.

(b) Disconnect the battery harness from the fusible link assembly.

(c) Wait 15 seconds, then reconnect the battery power harness to the fusible link assembly.

(d) Reset the serial number, time, and date.

(e) Replace the 3.6 volt lithium battery and retaining clip on the control motherboard.

(5) Install the cover panel with the eight screws and washers.

(6) Return unused items to the cover panel.

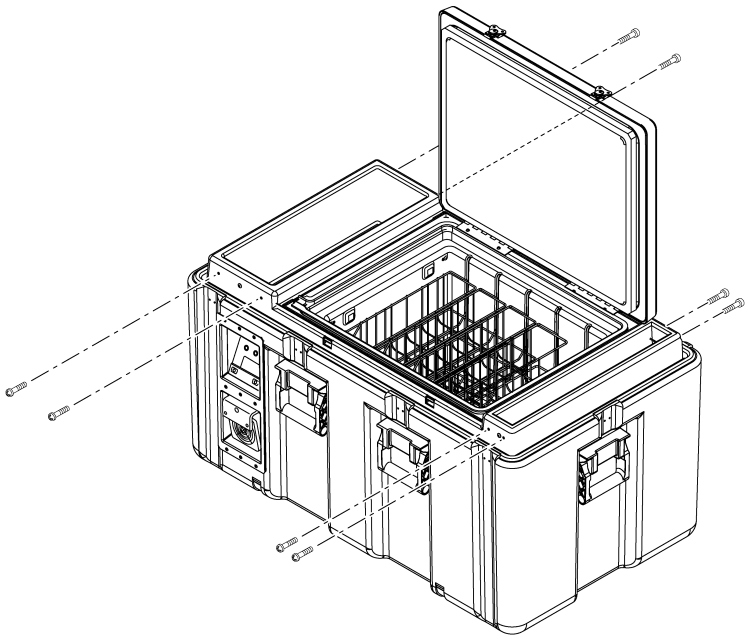


Figure 2-3. HemaCool® Battery Access

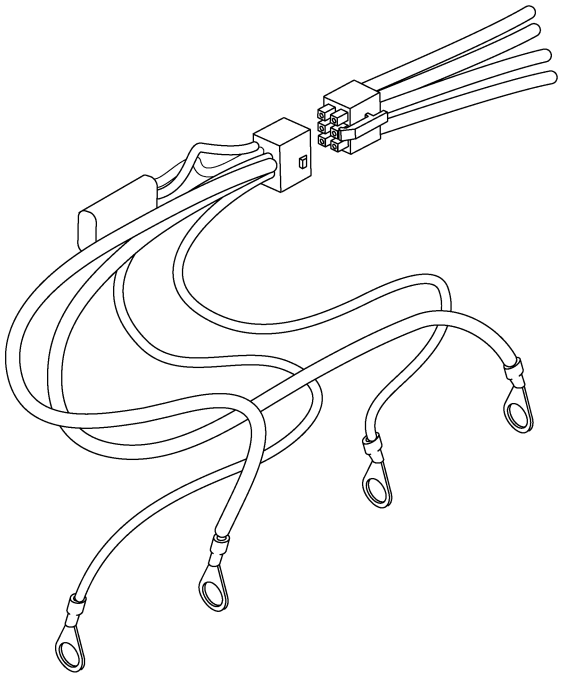


Figure 2-4. Battery Connection

CAUTION

- Do not turn on the HemaCool® until you have read this manual. Failure to understand the meaning of the LED readouts could result in loss of stored blood, blood products, or medical supplies and possibly damage the unit.
- During operation, the unit must not be situated so that air inlets or outlets are blocked or obstructed. The refrigeration system must be able to release heat to cool the payload properly.
- The unit should not be operated in a small, non-ventilated area. The refrigeration system must be able to release heat to cool the payload properly.
- Selecting the wrong set point for your materials can damage or destroy them. It is the operator's responsibility to choose the control set point that matches the temperature requirements of the payload. If in doubt, contact the manufacturer of the materials to be stored for the temperature requirements, so that the correct control set point is selected. The set point selected is indicated on the LCD readout (COOL or FREEZE) on the third row of Information Page 1. (See LCD Display, Chapter 1).

b. Attach the external source of power selected for the unit's initial start-up (cool-down) period. Plug the power source into the power panel (Figure 2-5) on the left side of the unit.

Figure 2-5. HemaCool® Power Panel

c. Depress ON/OFF button for 2 seconds (Figure 2-6). If you are operating on battery power only, the unit will run and the second row of text on the LCD will display “Batt %”. When operating on AC power, the unit will run and the second row of text on the LCD will display “Batt % EXT POWER”. This is how you can be sure your AC power is connected.

Figure 2-6. HemaCool® Display and Control Panel

d. Select the desired operating temperature by pressing DISPLAY and MODE buttons simultaneously.

(1) The COOL (4°C (39°F)) control point is ONLY used for storing materials that must be stored above freezing.

(2) The FREEZE (-22°C (-7°F)) control point is ONLY used for materials to be stored frozen. (If the ambient temperature is more than 30°C (86°F), the device may not have the capacity to hold the payload at FREEZE temperature below -20°C (-4°F). See Specifications, Chapter 5.)

CAUTION

The HemaCool® must be started and allowed to operate and stabilize at preset temperatures before the payload is put in place. This ensures that the unit's batteries are fully operational. Battery charge level is shown on the display (Figure 2-7). For optimum field storage time, it is suggested to not begin a portable mission if the battery voltage is below 13.5 volts.

(3) The temperature within the HemaCool® may reach satisfactory levels for storing the payload well before the batteries are fully charged. However, the unit will not achieve peak energy efficiency until 24 hours of continuous operation has been completed.

(4) Before reaching preset temperature, the unit's power demand will be above average. Therefore, it is recommended that charging be done with an external AC power source during the initial start-up (cool-down) period.

(5) After the battery is fully charged, the unit may be disconnected from the cabled power source. It is then portable and under internal battery operation. If the unit is disconnected long enough for the payload space to reach ambient temperature, the initial start-up (cool-down) period must be repeated.

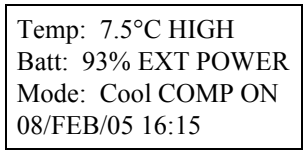


Figure 2-7. Battery Charge Level

2-5. CHANGE OF MODE

CAUTION

Selecting the wrong set point for your materials can damage or destroy them. It is the operator's responsibility to choose the control set point that matches the temperature requirements of the payload. If in doubt, contact the manufacturer of the materials to be stored for the temperature requirements, so that the correct control set point is selected. The set point selected is indicated on the LCD readout (COOL or FREEZE) on the third row of Information Page 1. (See LCD Displays, Chapter 1.)

a. The temperature control point may be changed during operation.

b. This is done by depressing both the DISPLAY and the MODE buttons at the same time, until the mode change shows on the display.

c. Care must be taken not to damage stored blood or blood products.

d. If the temperature is changed during operation, the HemaCool® must be allowed to stabilize to the new temperature set point before it is used to store or transport materials at the new temperature.

2-6. LOADING

a. The HemaCool® is equipped with 10 easy loading individual baskets for storage of blood and blood product (Figure 2-8).

b. Baskets slide into the liner in two courses (upper and lower) of five baskets each.

c. Each basket holds four 450-ml bags or six 250-ml bags.

d. Load bags evenly into both sides of basket.

e. Align ends of the baskets with slots in the liner and slide into the HemaCool®. Upper-course baskets rest atop lower-course baskets.

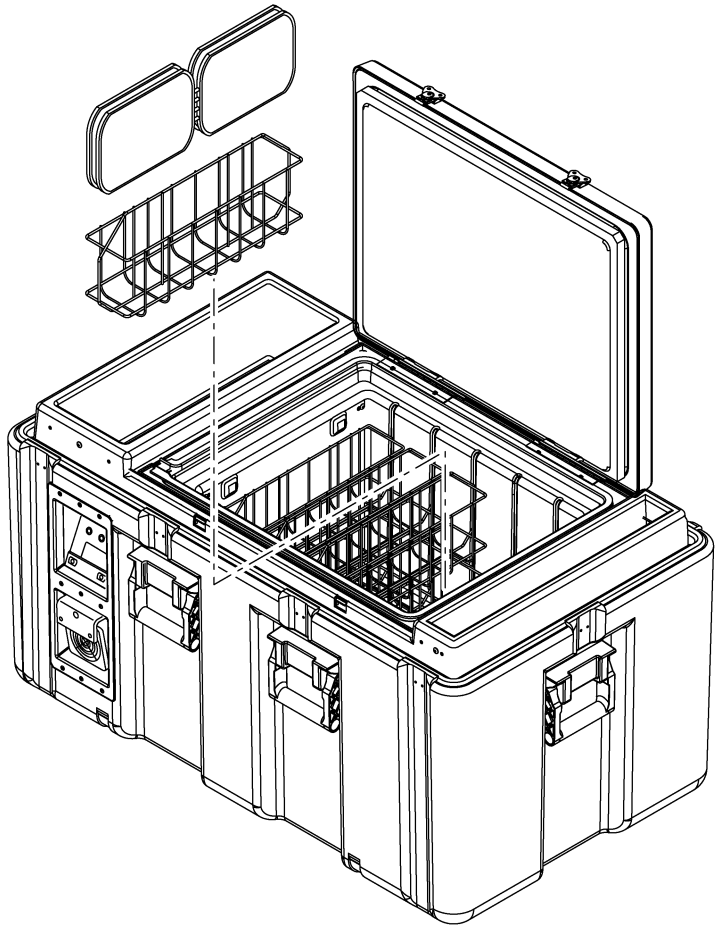


Figure 2-8. HemaCool® Loading

CHAPTER 3. OPERATOR MAINTENANCE AND TROUBLESHOOTING

Section I. Operator Troubleshooting

3-1. TROUBLESHOOTING

WARNING

- THE HEMACOOL® UNIT WEIGHS 142 LBS (64.5 KGS) EMPTY AND UP TO 180 LBS (81.7 KGS) LOADED. ALWAYS USE AT LEAST TWO PEOPLE WHEN LIFTING OR MOVING THE UNIT TO PREVENT PERSONAL INJURY.
- DISCONNECT ALL EXTERNAL POWER SOURCES BEFORE CONNECTING OR DISCONNECTING BATTERIES. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.
- DISCONNECT ALL EXTERNAL POWER SOURCES. REMOVE THE CASE LID THEN REMOVE THE COVER PANEL AND DISCONNECT BATTERIES BEFORE PERFORMING MAINTENANCE OR SERVICE. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.

Operator Troubleshooting			
TASK	**PASS**	**FAIL**	**FAIL ACTION**
Check line fuses if unit blower does not run constantly when operating on AC power.			Replace fuses.
Check intake filters for dirt accumulation daily.			Clean.
Check lid gaskets for cleanliness and debris weekly or when water accumulates inside.			Clean; remove debris.
Check lid gaskets for cuts or tears weekly or when water accumulates inside.			Initiate repair work order (WO).
Check bottom of inside tub for water accumulation daily in high humidity; weekly in dry conditions.			Remove water.
Check battery terminals for corrosion.			Initiate a repair WO.
Keep batteries charged; ensure unit reads above 13.5 V on display daily.			Plug into AC power to recharge at next opportunity. If batteries don't charge, initiate a repair WO.
Make general check for missing, damaged, or corroded parts.			Initiate a repair WO.

Section II. Operator Maintenance Task Details

3-2. CHANGE FUSES

a. The AC power fuses (1, Figure 3-1) are located adjacent to the power input connectors (2).

b. To remove a fuse, press inward on the fuse holder cap while turning it one quarter-turn CCW and pull it straight out.

c. Insert a new fuse (item 100523) and reverse the procedure.

Figure 3-1. Fuses

3-3. CLEAN INTAKE FILTERS

a. Removal.

(1) The two filters (1, Figure 3-2) are located below the display (1, Figure 3-3) and control panel and one below the power panel.

(2) The top of each filter is locked in place by a recessed slotted quarter-turn stud (2) and the bottom edge is placed behind the two inner bezel rivets (3).

(3) Insert a 1/4-in flat-bladed screwdriver through the hole in the handle (4) of the display and control panel filter (1). Turn the slotted quarter-turn stud (2) one quarter-turn CCW to unlock the filter (1).

(4) Grasp underneath the filter handle (4) and pull outward.

(5) Repeat steps (2) thru (4) for the filter on the power panel (Figure 3-3).

b. Cleaning.

(1) Clean filters with running water or with a mild soap (dishwashing liquid is acceptable) and water.

(2) Rinse filters thoroughly with fresh water.

(3) After rinsing filters, blow dry or allow to air dry.

c. Installation.

(1) Place the bottom edge of the filter (1, Figure 3-3) into the power panel behind the two inner bezel rivets (3).

(2) Ensure that the slot in the quarter-turn stud (2) is vertical, then push the filter (1) firmly inward.

(3) Insert a 1/4-in flat-bladed screwdriver and turn quarter-turn stud (2) CW until it is fully engaged.

(4) Pull on the filter handle (4) to make sure the filter (1) is locked in place.

(5) Repeat steps (1) thru (4) for the display and control panel filter (Figure 3-2).

Figure 3-2. Control Panel Filter Location

Figure 3-3. Power Panel Filter Location

3-4. INSPECT LID GASKETS

a. When the lid gaskets (2, Figure 3-4) are in good working order, there should be little or no accumulated moisture found inside the HemaCool®, unless the lid (1) is opened and closed frequently.

b. If a lot of moisture seems to be accumulating while the lid (1) is kept closed, it may be that the lid gaskets (2) are dirty, the lid is closing on debris, or it is cut or damaged.

c. To inspect the gaskets (2), open the lid (1) and look for dirt and debris accumulation on the black rubber gaskets and along their edges.

d. Check for dirt and debris along the gasket's mating surface (3) inside the unit. Clean the unit using a damp sponge, if needed.

e. Cleaning with a damp sponge should be done quickly, so the payload does not need to be moved to another refrigerator during cleaning.

f. Mild cleanser, such as Soft Scrub™ may be used to assist in cleaning, but must be rinsed away thoroughly afterward.

g. Cleaning with soap, then rinsing, requires the payload be moved to another storage refrigerator during cleaning to protect the payload both from heat and contamination.

h. If it should become necessary, the plastic parts of the HemaCool® may also be wiped with a 10 percent solution of chlorine bleach.

i. The unit's payload, if salvageable, must be moved to another refrigerator while cleaning with a bleach solution.

j. The bleach must be rinsed away and the unit allowed to dry before placing it back in service.

k. If cuts or tears in the gaskets (2) are found, refer the unit to a qualified technician for replacement (see HemaCool® Service Manual).

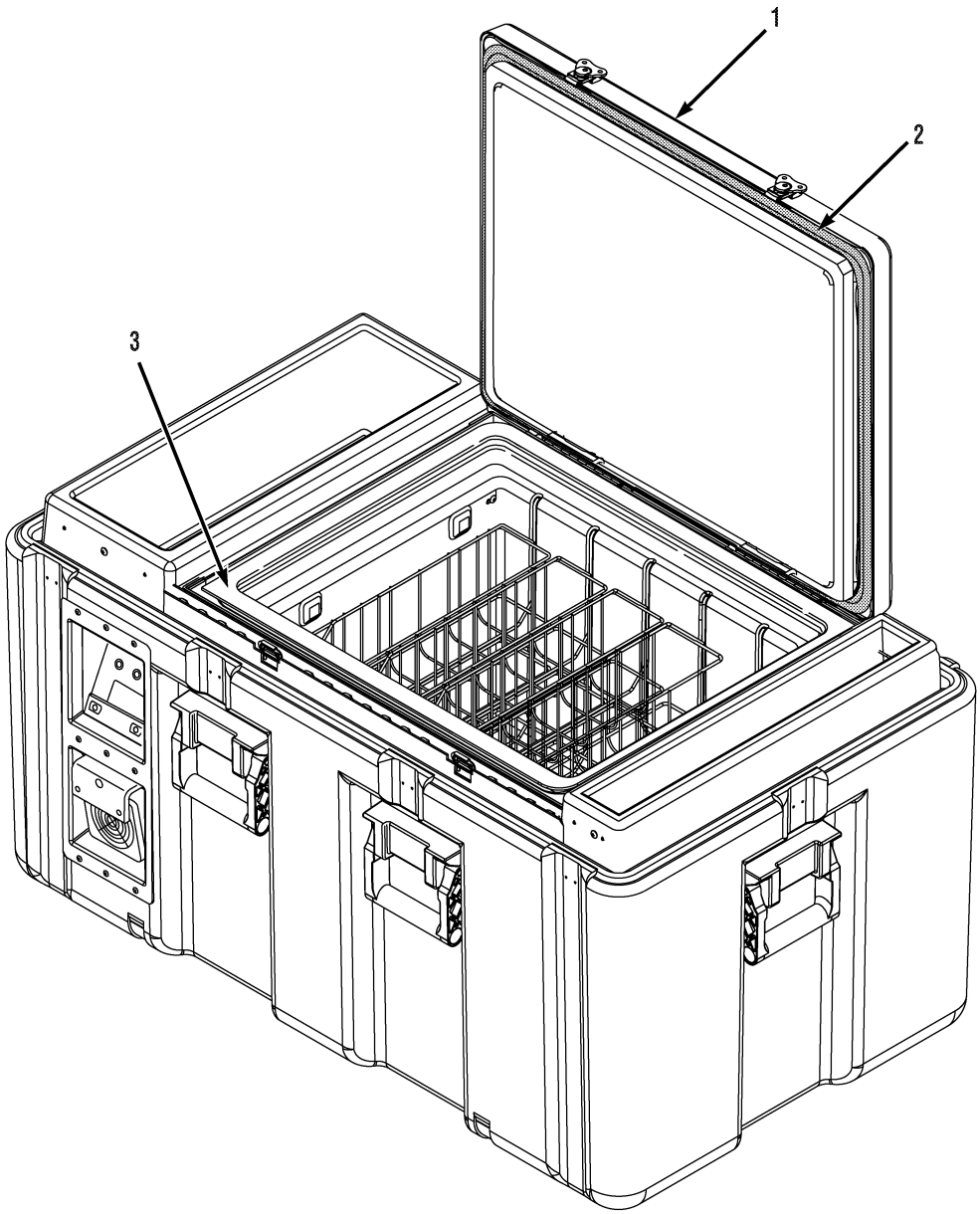


Figure 3-4. Inspecting Lid Gasket and Mating Surface

3-5. INSPECT FOR MOISTURE ACCUMULATION

a. If the unit's seal is compromised, or if it is opened and closed frequently in a humid environment, moisture will accumulate in the bottom of the tub.

b. This moisture may be removed using a sponge or absorbent towels.

c. If a sponge is not sufficient to absorb accumulated moisture, use a wet-dry shop vacuum cleaner to remove excess moisture.

3-6. INSPECT FOR BATTERY TERMINAL CORROSION

a. If the unit is in a humid or hot environment, check for battery terminal corrosion once a month.

b. If the unit has symptoms of poor battery performance (short run-time on batteries), check for battery terminal corrosion.

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- DISCONNECT ALL EXTERNAL POWER SOURCES. REMOVE THE CASE LID THEN REMOVE THE COVER PANEL AND DISCONNECT BATTERIES BEFORE PERFORMING MAINTENANCE OR SERVICE. FAILURE TO COMPLY MAY RESULT IN INJURY OR DEATH TO PERSONNEL.

c. To check for battery terminal corrosion, remove the contents from the cover panel (1, Figure 3-5).

d. Remove eight screws (2) and the cover panel (1).

e. The battery terminals (3) are visible after the cover panel is removed.

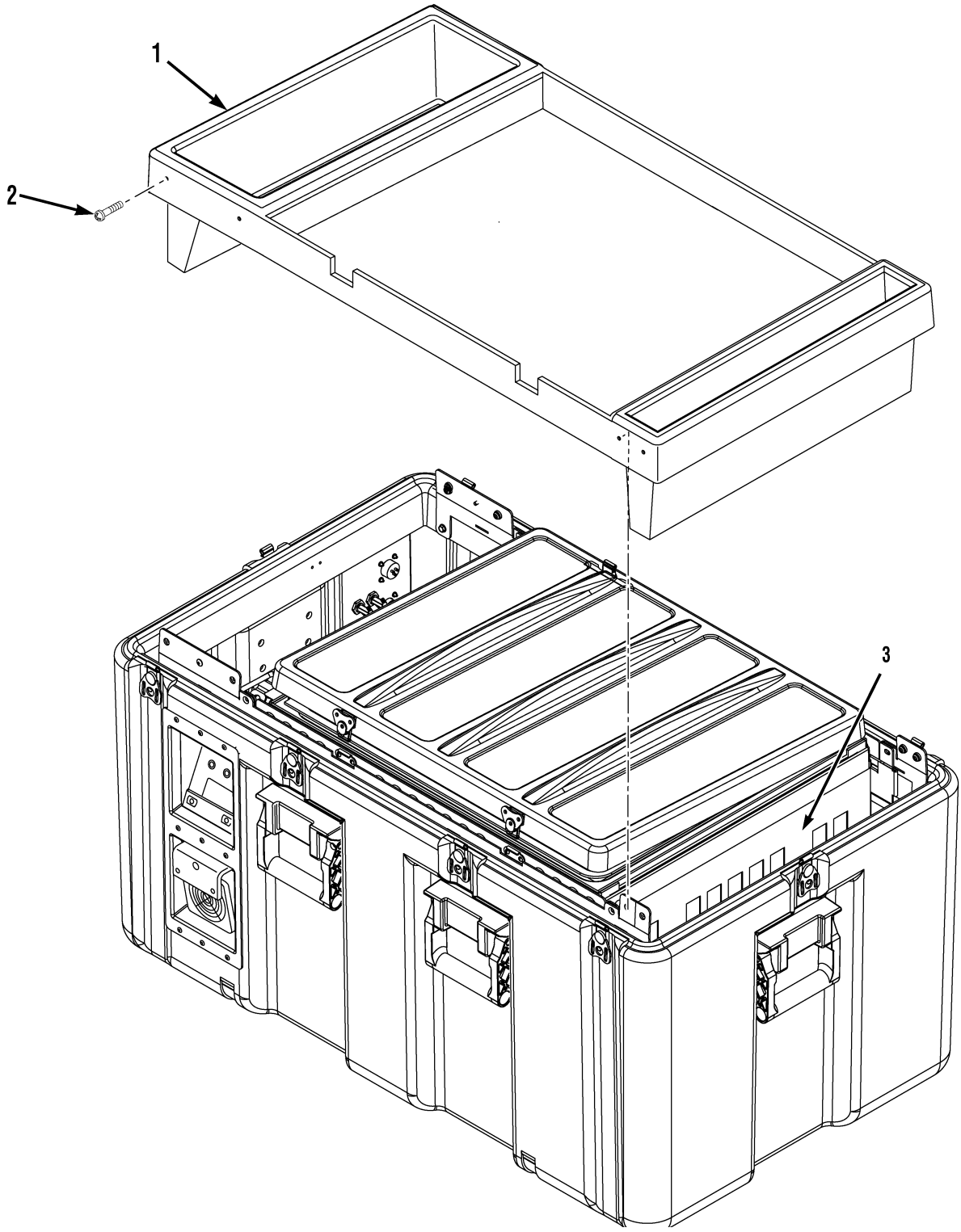

Figure 3-5. Battery Terminal Locations

3-7. KEEP BATTERIES CHARGED

a. The batteries in this unit require a full charge to maintain their full capacity. Allowing a discharged battery to sit, without recharging, begins to deteriorate its capacity to hold a new charge in as little as a few hours.

b. When the unit is plugged into external power, the batteries will charge.

c. Batteries that are fully discharged may require as much as 24 hours to fully recharge on external power.

d. If fully recharged batteries run down quickly, initiate a repair WO.

3-8. OTHER REPAIR AND MAINTENANCE

a. Other maintenance, such as replacing the main batteries, the data logger battery, or the indicator lamps cannot be performed by the operator. A qualified technician must perform these tasks. Both battery sets should last several years (up to five), but such indicators as shortened battery operating time may indicate that conditions have made it necessary to replace batteries sooner.

b. Qualified technicians must also handle all repair work. If none are available, arrangements may be made to return the HemaCool® to the factory for repair. AcuTemp can also be contacted to provide training for technicians.

c. Operating principles, technical diagrams and procedures, and more comprehensive part lists than those described in this manual appear in the HemaCool® Service Manual.

CHAPTER 4. ACCESSORIES

The following items are supplied with each HemaCool® unit.

Description	Part Number
AC Power Cord	100970
DC Power Cord	100968
Manual/Tool Kit Assembly	101957
Replacement Filters, bag of 10 (Incl. in PN 101957)	101964
CD - Operation and Maintenance (Incl. in PN 101957)	101962
CD - Service and Repair (Incl. in PN 101957)	101963
CD - Hemalog Software (Incl. in PN 101957)	102009
No. 2 Phillips-Head Screwdriver (Incl. in PN 101957)	100631
Cellulose Sponge (Incl. in PN 101957)	101832
Bubble-Out Storage Bag (Incl. in PN 101957)	101961
Blood Baskets	100000
2 Batteries, 21 amp-hour	101880
Manual, Operation and Maintenance	102010
Manual, Service and Repair	102011

CHAPTER 5. MISCELLANEOUS

Section I. HemaCool® Specifications

5-1. MODEL HMC-1-MIL

a. Internal Temperature regulation:

(1) COOL mode: 4.0±1.0°C (39°F ±2°F)

(2) FREEZE mode: -22°C +0/-6°C (-7°F +0/-11°F) in 30°C (86°F) ambient or lower temperature

b. Weight is 142 lbs (64.5 kgs)

(1) Empty with batteries:

c. Estimated power consumption during COOL mode chilling: <40 W at room temperature (55 W at 40°C (104 °F) ambient)

d. Estimated power consumption for COOL mode storage only: <20 W at 40°C (104°F) ambient

e. Payload capacity: 40 x 450 ml units or 60 x 250 ml units

f. Exterior dimensions: 21.8 in. (55.4 cm) H x 21 in. (51.3 cm) W x 37.5 in. (95.2 cm) L

g. Interior dimensions: 13 in. (33.0 cm) H x 14 in. (35.6 cm) W x 18 in. (45.7 cm) L

h. Batteries:

(1) 12 volt, 42 amp-hour total capacity

(a) Set contains two 21 amp-hour batteries

(b) Battery weight (total): 27 lbs (12.2 kg)

(c) Provides 24 hours of operation in storage only (no chilling of warm material) mode

i. Accommodates a variety of power sources:

(1) AC power from grid or generator.

(2) Batteries or external 12-28 VDC to auxiliary input.

(3) Grid power required: Any combination of 100-250 VAC and 50-60 Hz

j. Employs environmentally safe R 134A refrigerant.

Section II. WARRANTY

The HemaCool® is warranted to be free from defects in manufacturing and workmanship for a period of one (1) year from the date of purchase. Customer abuse is not covered by this warranty. This limited warranty covers repair or replacement of the unit at AcuTemp's discretion. In no event shall AcuTemp be liable for any indirect, special, consequential, or incidental damages, including but not limited to, damages for loss of use of equipment, loss of revenue, loss of product, loss of profits, or loss of goodwill, regardless of whether AcuTemp (a) has been informed of the possibility of such damages or (b) is negligent. If the unit fails during the warranty period, it must be shipped to AcuTemp or the factory-designated service center for repair or replacement. The unit must be packaged such that it will not be damaged in transit and insured for its full value. Should the failure be attributed to customer abuse, AcuTemp will charge the customer for the repair costs.

This manual is solely for the HemaCool® HMC-MIL-1. It provides a set of instructions for the unpacking, operating, data logging, and routine maintenance of the unit.

For assistance with this unit, or any AcuTemp product, e-mail support@acutemp.com or telephone 937-312-0114 and ask for technical support.

APPENDIX A. SCHEMATICS AND BOARD LAYOUTS

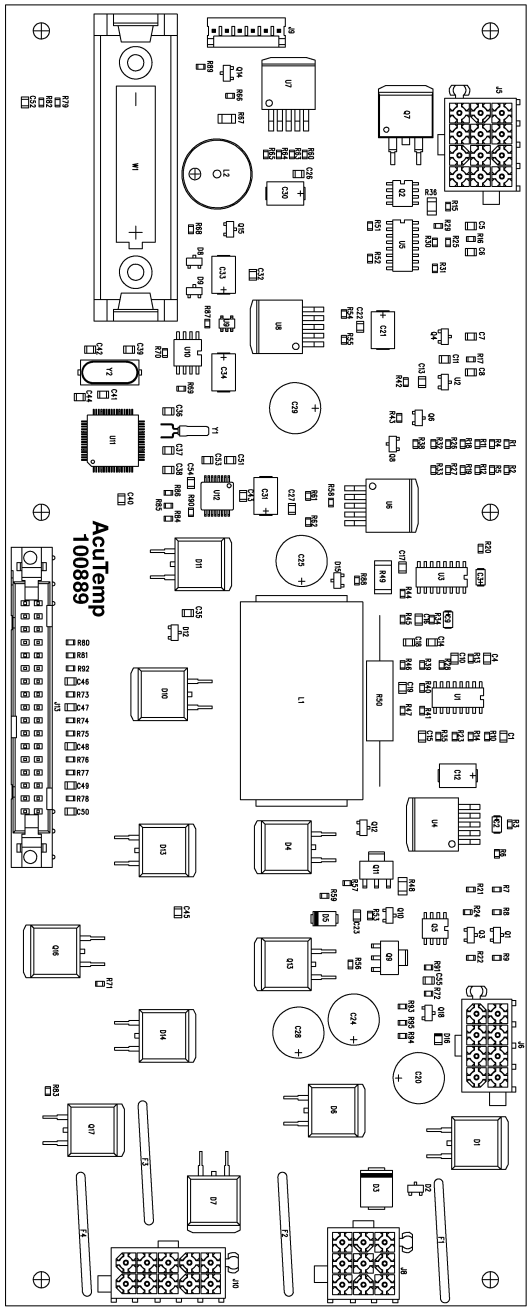

Figure A-1. Control Motherboard Layout

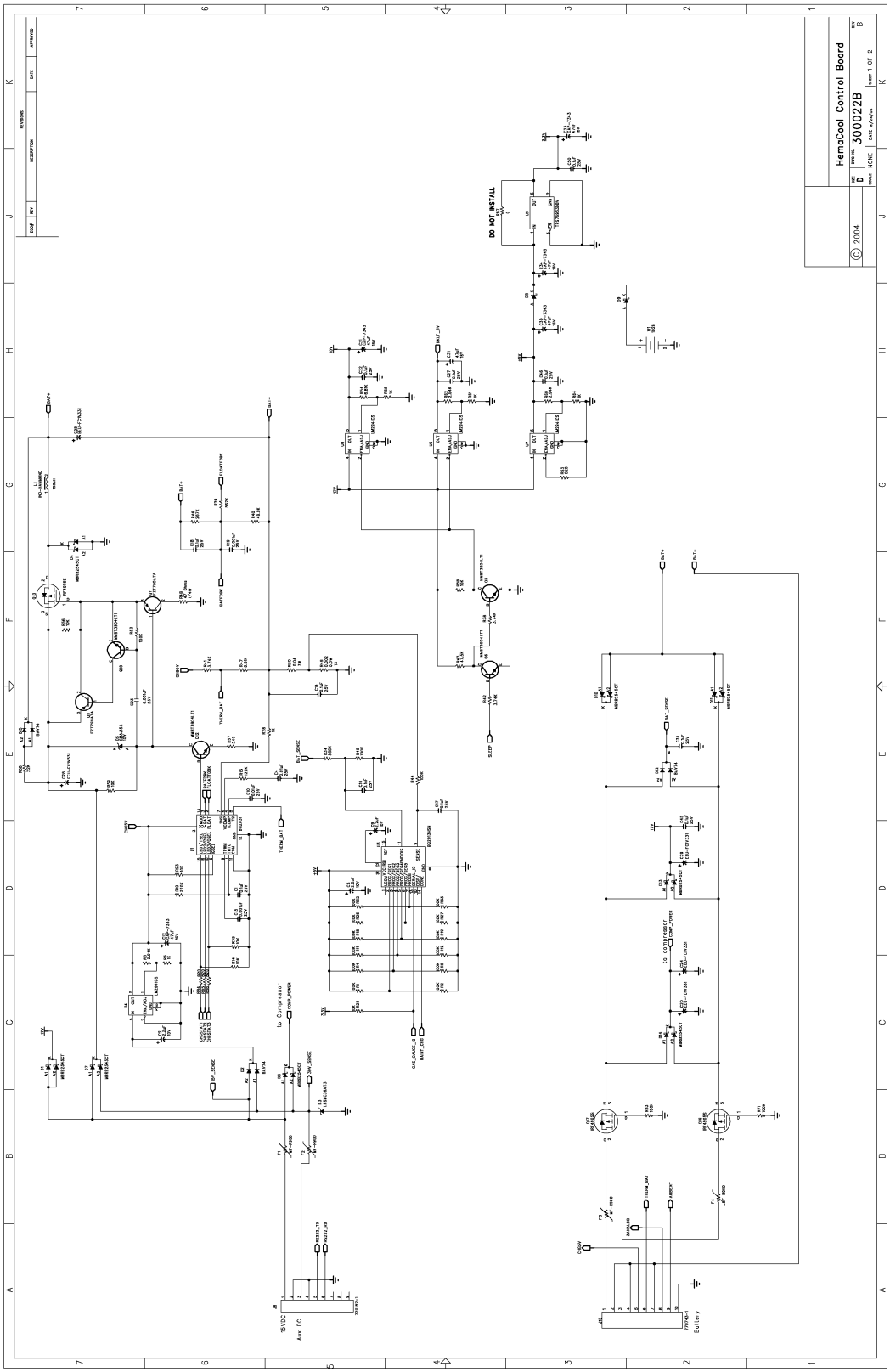

Figure A-2. Control Motherboard Schematic (Sheet 1 of 2)

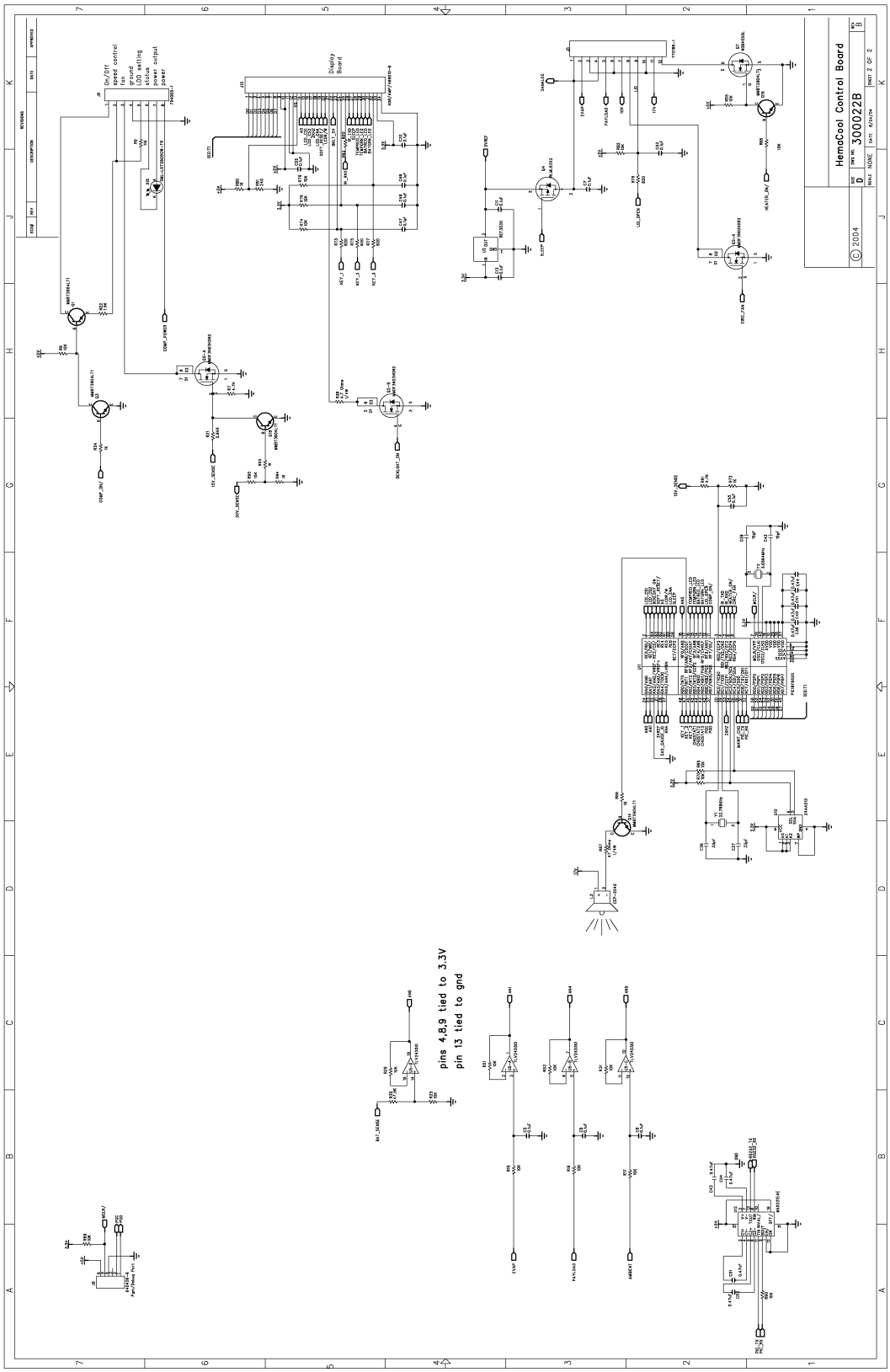

Figure A-2. Control Motherboard Schematic (Sheet 2 of 2)

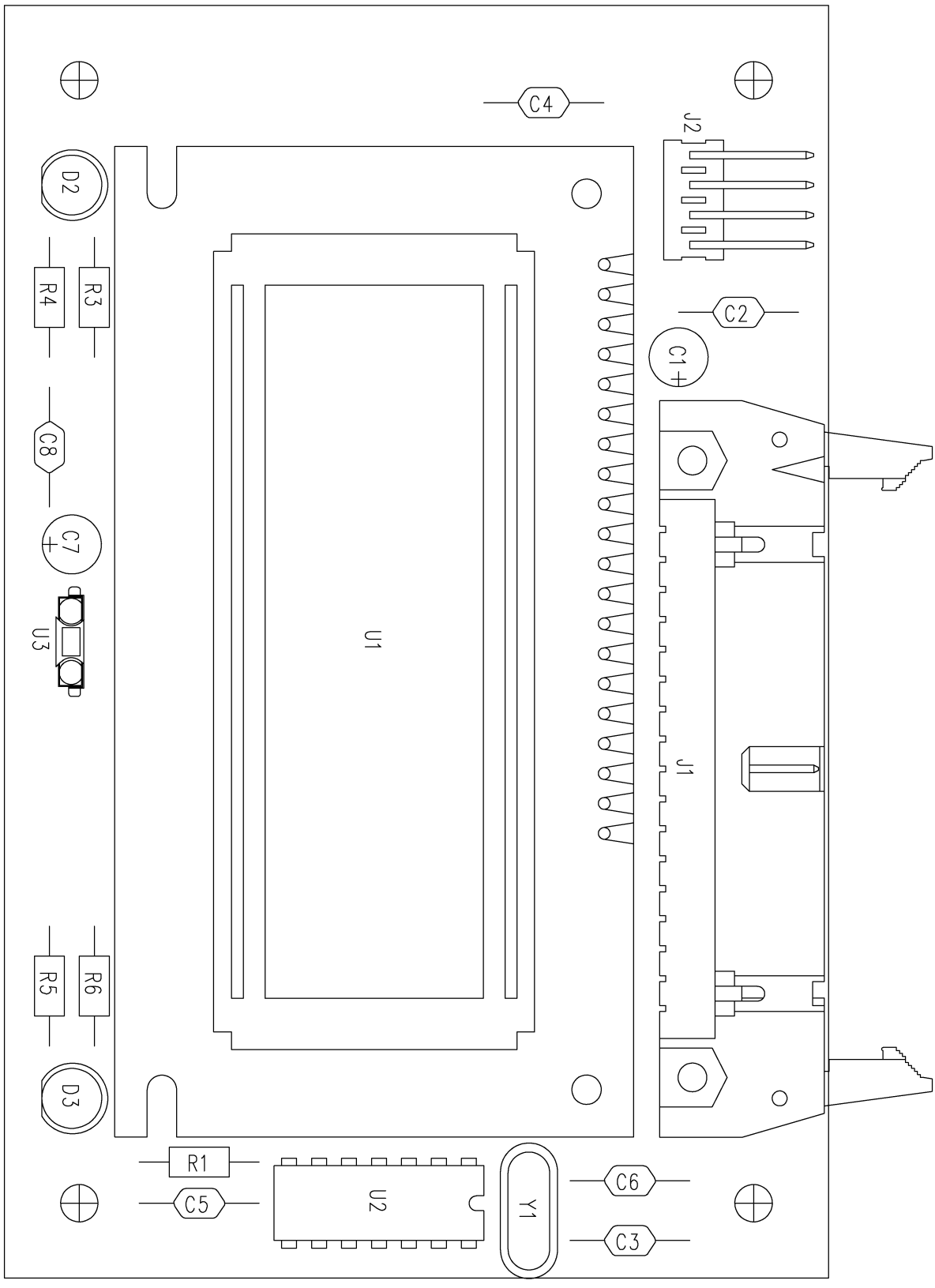

Figure A-3. Display Circuit Board Layout

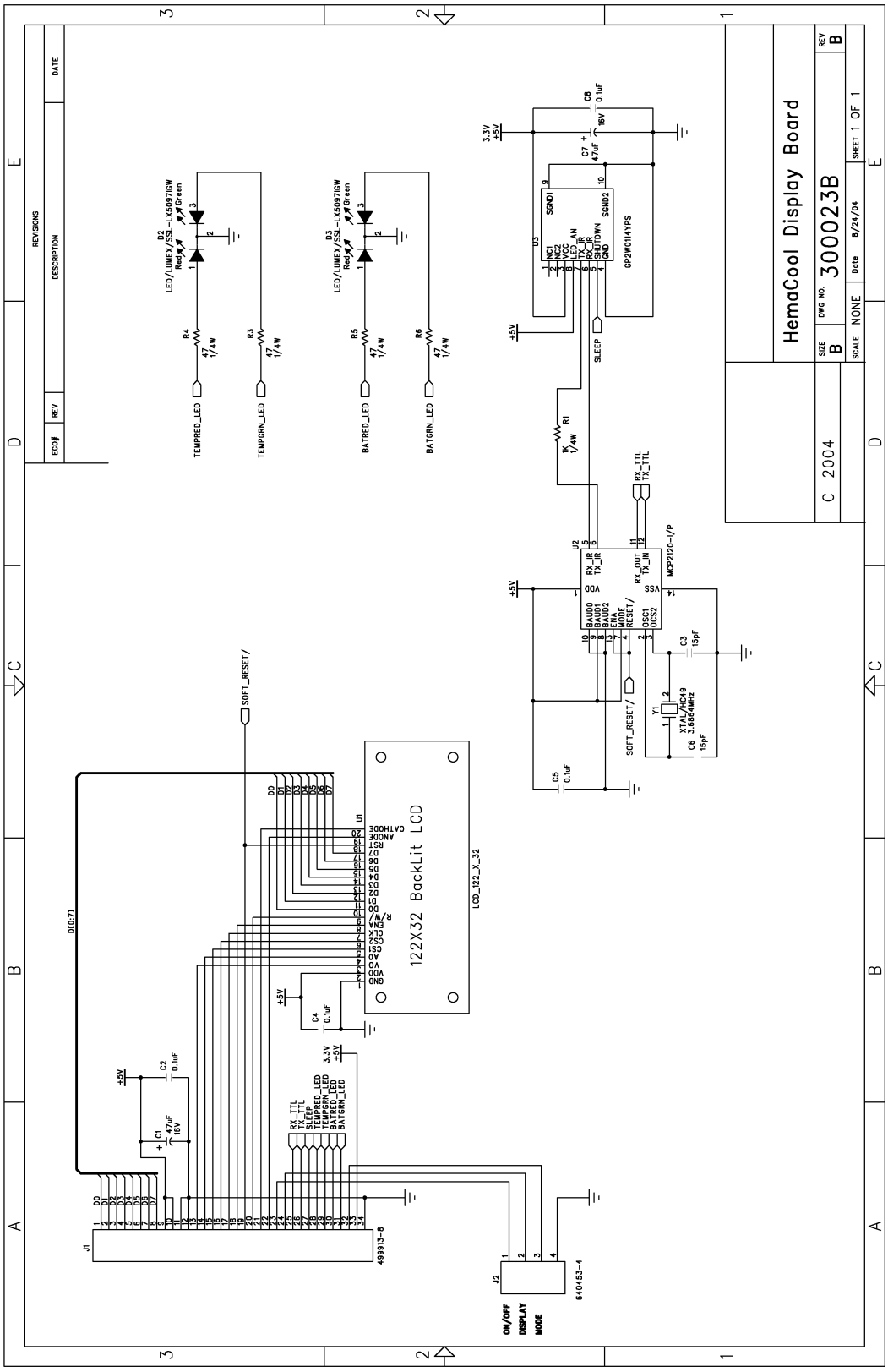

Figure A-4. Display Circuit Board Schematic